SCIENCE FORM 2
CHAPTER 2 NUTRITION

Purpose of taking food

I. Obtain energy to perform daily activities
II. Obtain materials that needed to build, repair, and maintain body tissues
III. Food supplies the substances that help regulate the body processes
IV. Food keeps the body tissues and organs healthy

Nutrition

- Is the process of making or obtaining the food necessary for health and growth
- The science of food, the nutrients and other substances within food
- The action, interaction and balance of these nutrients in relation to health and disease
- The process by which the organism ingest, absorb, transport, use and excrete food substances

What is meant by a good nutrition?

-Good nutrition means to eat at right meal time and that ones meal must contain all the classes of food in the right proportion.

7 classes of food

i. Carbohydrates
ii. Proteins
iii. Fats
iv. Vitamins
v. Minerals
vi. Fibre
vii. Water

Macronutrients: Carbohydrates, Proteins, Fats
Micronutrients: Vitamins, Minerals

CARBOHYDRATES

- Are the food substances consisting of carbon, hydrogen and oxygen in their molecules
- H:O ratio is 2:1
- Carbs include sugars, starch, glycogen and cellulose(made up by glucose)

i. Sugars:
   a. Simplest unit of carbs
   b. compounds that taste sweet and water soluble
   c. glucose, sucrose, lactose, maltose are examples of sugar
ii. Starch:
   a. Carbs stored in plant cells
   b. Rice, potatoes and tapioca have plently of starch
iii. Glycogen:
   a. Stored in animal cells
   b. Mainly stored in liver and muscles
iv. Cellulose:

a. Cell walls of plant

- Function of Carbs:
  - Supply energy for body processes
  - Spare protein for body tissues building and repairing
  - Essential for oxidation of fats to produce energy
- Low Carbs intake:
  - Ketosis caused bad breath, acidic blood cause damage in liver and kidney
  - Hypoglycemia: Fatigue, confusion
- High Carbs intake:
  - Diabetes mellitus 糖尿病
    - blood glucose level above the normal value
    - insufficient insulin to convert excess glucose to glycogen
  - Obesity 肥胖/overweight
    - may lead to cardiovascular disease, high blood pressure, atherosclerosis, diabetes mellitus, cancers
  - Dental caries 龋病 / 蛀牙

PROTEINS

- Are food substances that contain carbon, hydrogen, oxygen , nitrogen , sulphur and phosphorus
- Basic units of protein known as amino acids
- Animal proteins: fish, eggs, meat
- Plant proteins: nuts, beans, seeds
- Function of proteins:
  - For growth and repair damage tissues
  - Used to synthesis enzymes and hormones
  - Form antibodies to prevent infection and illness
  - Source of enegy
- Low Proteins intake:
  - Marasmus
    - Caused by severe lack of protein and energy-providing nutrients
    - Becomes skinny, stunted (发育迟缓), loss of weight
  - Kwashiorkor
    - Due to lack of proteins
    - Growth stunted
    - Oedema due to increased interstitial fluid content because there is not enough protein in the blood to hold back the water

- High Proteins intake:
  - Increase the uric acid (尿酸) content in the blood.
  - Gout (痛风) – uric acid forms crystals in the soft tissues of the joints
  - Kidney stones & kidney damage –uric acid crystallised
  - Avoid foods high in purine-containing

- Reduce brain function (Ammonia accumulated due to liver overworked)

FATS

- Consists of carbon, hydrogen and oxygen (fats contain less oxygen in proportion of hydrogen)
- Fats which are liquid at room temperature known as oil.
- Fat molecule consist of a glycerol and 3 fatty acids molecules
- Eg. Butter, margarine, fatty meats
- Function of fats:
  - Source and storage of enery
  - Fatty tissues protects internal organs
  - Act as solvent for Vitamin ADEK absorption
  - Use to form phospholipid bilayer plasma membrane
  - Skin insulator helps to sustain normal body temperature
- Low Fats intake:
  - Poor vitamin absorption
  - Both omega-3s and omega-6s play roles in mood and behavior(fatty acids help to insulate nerve cells in the brain)
- High Fats intake:
  - Cardiovascular diseases (disease of the heart & blood vessels)
    - including high blood pressure, stroke, heart diseases
  - Atherosclerosis
    - deposit of plaques develop on the internal lining of the blood vessels causes the narrowing of lumen of blood vessels
  - Arteriosclerosis 动脉硬化症
    - the plaques in the arteries become hardened by calcium deposits

WATER

- Make up 70% of the total body weight.
- A normal adult requires ~ 2 – 2.5 litres of water daily
- Water loss & failure to replace it cause dehydration.
- Function of water:
  a) medium for all cellular biochemical reactions.
  b) medium of transportation for respiratory gases & nutrients.
  c) Regulates body temperature.
  d) Removes excretory waste
  e) Maintains osmotic pressure in the tissue fluid & blood plasma.
  f) Aids peristaltic movement
  g) Enables hydrolysis of food substances during digestion.
  h) Dissolves most chemical substances.
- How much water you require a day?
  - Body Weight (kg) x 40 ml =_____ml

VITAMINS

- A group of organic compound needed in small quantities.

- Vitamins provide no energy but are essential for the maintenance of good health and efficient metabolism. Their absence from the diet will cause deficiency disease.
- Grouped into 2 categories:

i. Fat-soluble vitamins
-- vitamin A, D, E, K
-- can be stored in body fat

ii. Water-soluble vitamins
– vitamin B & C
-- cannot be stored in body, excess intake is excreted

c

K (phylloquinone)	Egg yolk, cabbage, spinach	- blood clotting	- excessive bleeding → anaemia
B1 (thiamine)	Yeast extract, cereals, nuts, milk, liver, legumes	- precursor of coenzyme in carbohydrate metabolism	- beri-beri: muscle weakness, nerve disorder, swollen feet)
B2 (riboflavin)	Yeast extract, cereals, nuts, milk, liver, legumes, egg, dairy products	- components of coenzymes in energy metabolism - healthy nervous system	- sore eyes, swollen tougue, skin lesions
B3 (niacin)	Liver, lean meat, legumes, unpolished rice, fish, yeast extract	- components of coenzymes in energy metabolism	- Pellagra: skin and gastrointestinal lesions, nervous, mental disorders, loss appetite)

B5 (pantothenic acid)	Egg yolk, green vegetables, fish, liver, meat	- Components of coenzymes in energy metabolism	- Muscle cramp, fatigue, impaired motor coordination
B6 (pyridoxine)	Yeast extract, whole grains, legumes, fish, liver, milk, potatoes, meat	- coenzymes in amino acid metabolism	- irritability - muscular twitching - retarded growth - kidney stones
B9 (Folic acid)	Green vegetables, oranges, nuts, legumes, whole grains	- acts as coenzyme in nucleic acid & amino acid metabolism	- Anaemia - Gastrointestinal disturbances, diarrhea - Birth defect
B12 (cobalamin)	Milk, meat, egg, cheese	- Coenzyme in nucleic acid metabolism - Proper development of red blood cell	- Pernicious anemia - Neurological disorder

H (Biotin)	Legumes, vegetables, meat	- Act as coenzyme in synthesis of fat, glycogen and amino acids	- fatigue - Depression - Nausea
C (ascorbic acid)	Citrus fruits, tomatoes, green pepper	- Synthesis of collagen - A strong antioxidant - Improves iron absorption - maintenance of cartilage, bone, dentin, blood vessels - Aids in detoxification	- poor collagen formation - scaly skin - delay wound healing - impaired immunity - epithelial haemorrhages - scurvy: swollen, bleeding gums, and tooth loss

MINERALS

- Simple inorganic nutrients
- Cannot synthesised by our body, must obtained from diet.
- Do not provide energy but are essential for the various functions of the body.

1)Macrominerals :

- major minerals
- required in relatively large quantities.
- eg: calcium, magnesium, phosphorus, sodium

2) Microminerals:

- required in trace amounts
- Eg: cobalt, fluorine, iodine, magnanese, zinc, molybdenum

Mineral	Dietary sources	Functions	Symptoms
Calcium	Milk, cheese, vegetables, grains	-Build and maintain bones and teeth -Maintain regular heartbeats -Prevent muscle cramps	-rickets in children -stunted growth -delay blood clotting -osteoporosis
Magnesium	-green leafy, vegetables, whole grains, meat	-For proper nerve and muscle function -Help in proper absorption of calcium -Healthy bones and teeth -Maintain heart rhythm	-retarded function of muscle and nerves
Iron	-green leafy, vegetables, liver, egg yolk, meat, legumes	-Prevent anemia -Overcome fatigue	-iron deficiency anaemia -reduced resistance to infection
Mineral	Dietary sources	Functions	Symptoms
Selenium	Organ meats, eggs, and seafood	-Work together with Vitamin E -Preserve elastic skin -Maintain blood circulatory -Prevent cancer	-muscle pain, weakness
Zinc	Meat, seafood, milk, whole grains	-Maintain body resistance -Tissue healing -Prevent hairloss -Visual health and taste perception -Breakdown alcohol -Prostate health	-poor growth and development -low immunity
Chromium	Liver, yeast, nuts and grains	-Pancreatic health and insulin effectiveness -Regulate blood sugar -Promote carbohydrates	Impaired glucose metabolism

FIBRE

- Consists mainly of cellulose that is indigestible because we lack of enzymes to digest it.
- Fruits and vegetables are rich in fibres
- Function of Fibre:
    - Lower cholesterol level and control blood sugar
    - Absorb water and help to remove waste material
    - Prevent constipation

FOOD TEST

i. Glucose
   a. Benedict solution test
   (glucose solution mixed with benedict's solution and mixture was boiled in water bath for 5 minutes)
   Result: brick-red precipitate produced

ii. Starch
   a. Iodine test
   (few drops of iodine were added to starch solution)
   Result: blue-black color formed

iii. Proteins
   a. Millon's test
   (albumen solution mixed with Millon's reagent and mixture was boiled in water bath for 5 minutes)
   Result: red coagulation formed

iv. Fats
   a. Emulsion test
   (ethanol and oil wew added and shaken and left for 2 minutes)
   Result: milky solution formed

BALANCE DIET

- Diet : everything we eat and drink
- Balance diet consists of all 7 classes of food in right amount

Factors determined a person's diet

i. Body size
   - Bigger size require more energy compared to smaller size

ii. Gender
   - Boys require more energy because boys have lower body fats content
   - Heat loss faster in boys

iii. Climate
   - Cold countries lose more heat, therefore need more energy to keep body warm

iv. State of health
   - Food intake must be appropriate to health problems

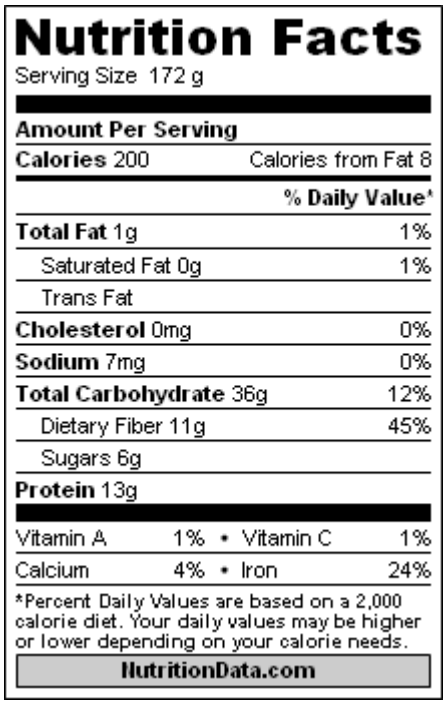
v. Physical activity
   - Active person should have higher energy intake

vi. Age
   - Young people need more energy than old people for growth

ENERGY VALUE

- Energy content of food is indicated by calorific or energy value
- Cabs, proteins and fats supply us energy
- Calorimeter: used to measure energy value of food
- Unit of energy
   - Calories (cal) or joules (J)
   - 1 cal = 4.2 J

Class of food	Energy value (KJ g^{-1})
Carbohydrates	17.2
Proteins	17.2
Fats	38.5



Nutrition Facts

Serving Size 172 g

Amount Per Serving	
Calories 200	Calories from Fat 8
	% Daily Value*
Total Fat 1g	1%
Saturated Fat 0g	1%
Trans Fat	
Cholesterol 0mg	0%
Sodium 7mg	0%
Total Carbohydrate 36g	12%
Dietary Fiber 11g	45%
Sugars 6g	
Protein 13g	

Vitamin A	1%	• Vitamin C	1%
Calcium	4%	• Iron	24%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

NutritionData.com

Calculation of energy

Fats = 1g x 38.5 KJ g^{-1}

= KJ

Carbohydrates =

=

Proteins =

=

Total of Fats + Carbs + Protein = _____KJ

Convert KJ become Kcal

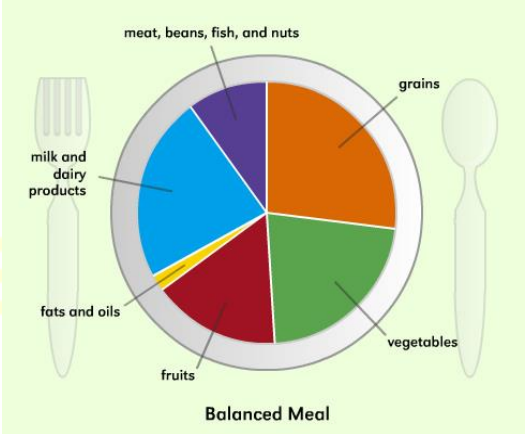
(1 cal = 4.2 J)

Ans:

Recommended daily energy needs

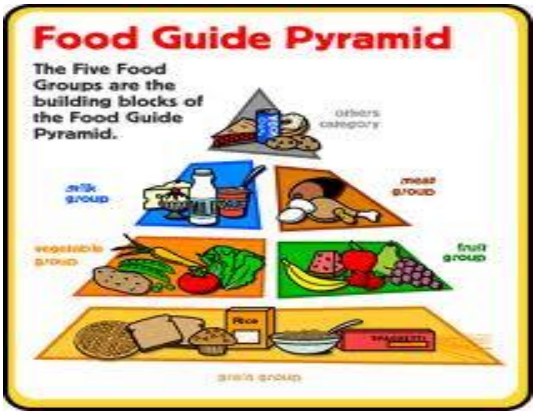
Age (years)	Female (kcal)	Male (kcal)
1–3	1165	1230
4–6	1545	1715
7–10	1740	1970
11–14	1845	2220
15–18	2110	2755
19–49	1940	2550
50–59	1900	2550
60–64	1900	2380
65–74	1900	2330

Healthy plate recommendation



Food Pyramid guide

- Food guide pyramid – illustrates the relative amounts of the different food groups that make up a balanced diet.



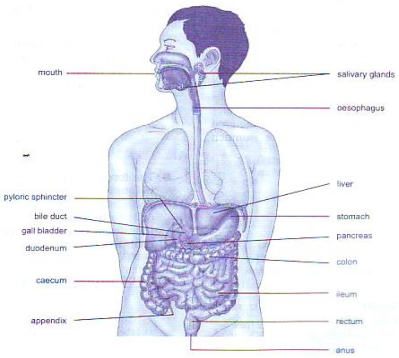
SCIENCE FORM 2
CHAPTER 2 NUTRITION (PART 2)

Food digestion

- food such as carbohydrates, proteins and lipids consist of large and complex organic compounds
- these complex substances need to be broken down into simple substances that can be absorbed by the cells
- digestion is the process of breaking down large and complex substances into simple molecules that can be absorbed
- carbohydrates, proteins and lipids are digested in the body into simple substances such as glucose, amino acids, fatty acids and glycerols
- these simple substances can be absorbed by the cells in the body to carry out metabolic processes in the cells

(A) Human digestive system

- human digestive system comprises of the alimentary canal which starts at the mouth and ends at the anus



- parts of the human digestive system are:
  i. mouth
  ii. oesophagus
  iii. stomach
  iv. duodenum (first part of small intestine)
  v. ileum (rest of small intestine)
  vi. large intestine (caecum, colon, rectum)

- digestion involves both physical and chemical processes

i. physical digestion is the breaking down of food particles by the teeth (chewing) into smaller food particles. This will increase the surface area of the food particles for enzyme reaction. Physical process also involves peristalsis which moves the food particles down the alimentary canal

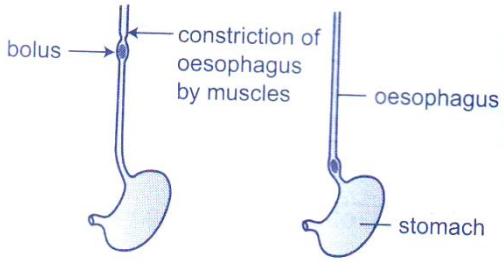
ii. chemical digestion is the breaking down of large complex molecules in the food into soluble, smaller and simple molecules by specific digestive enzymes in the presence of water. The process is called hydrolysis.

- digestive juices such as saliva, gastric juice, pancreatic juice and intestinal juice contain enzymes which aid in the process of digestion by hydrolysis
- other substances such as hydrochloric acid prepares an acidic medium for the enzymes to function in the stomach while the bile secreted by the liver emulsifies the fats to facilitate digestion of fats

(B) Digestion of carbohydrates, proteins and lipids in the human body

(1) Mouth

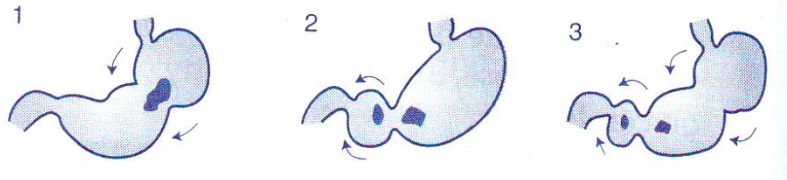
- food is chewed by the teeth into small particles to increase the surface area for the action of enzymes
- there are three pairs of salivary glands in the mouth to produce saliva
- saliva as a digestive juice contains water, salivary amylase (enzyme ptyalin) and mucus
- as the food is being chewed in the mouth, it mixes with the saliva which softens and shapes the chewed food particles into a lump called bolus
- saliva also moistens the food particles to facilitate the movement of the bolus down the oesophagus
- in the mouth cavity, only starch will be digested
- amylases breakdown carbohydrates
- bolus is forced into the oesophagus by the process of swallowing
- bolus will then, move along the oesophagus by a process called peristalsis. The longitudinal muscles and circular muscles in the wall of oesophagus contract and relax alternately to produce wave-like movements which move the food down the oesophagus until the stomach



Peristalsis action in the oesophagus

(2) Stomach

- gastric glands in the walls of stomach secretes gastric juice
- gastric juice contains hydrochloric acid, and the enzyme pepsin and rennin
- in the stomach, peristalsis action occurs to churn and mix the food with gastric juice



Peristalsis action in the stomach

- functions of hydrochloric acid:

prepares an optimum pH range of acidic medium for the action of enzymes pepsin and rennin
kills bacteria that are present in the food
stops the action of salivary amylase

- stomach wall secretes mucus to protect the stomach tissue from corrosion by the hydrochloric acid
- digestion of protein begins in the stomach
- proteases break down proteins.
- food remains in the stomach for three to four hours
- semi-solid and partly digested food is called chyme. It is slowly released from the stomach into the duodenum by contractions of stomach

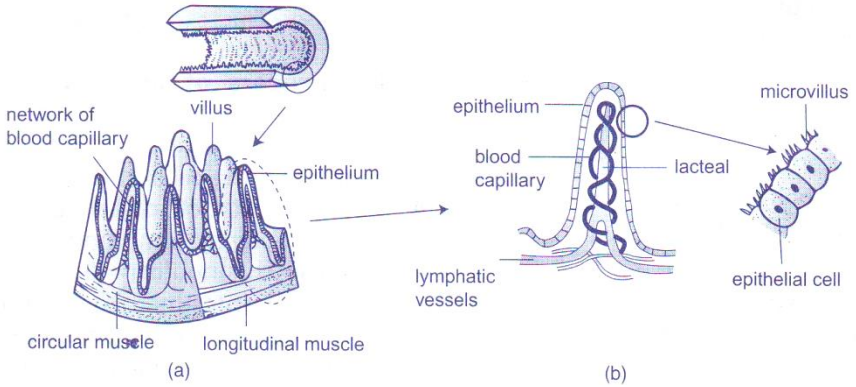
(3) Duodenum
- duodenum is the first part of the small intestine
- duodenum does not have glands to secrete digestive juice. It receives two secretions from other parts of the digestive system for digestion
- duodenum receives:
bile produced by the liver, stored and released from the gall bladder
pancreatic juice secreted by the pancreas
- bile is alkaline and does not contain enzymes
- functions of bile:
emulsifies fats by breaking up large globules of fats into small fat droplets in order to increase the surface area for the action of the enzyme lipase
prepares an alkaline medium for the action of enzymes
neutralises the acids in the stomach
speeds up the digestion of fats
- pancreatic juice is also alkaline and contains three enzymes which are lipase, amylase and trypsin
- function of the enzymes in pancreatic juice
(i) enzyme lipase hydrolyses fats into glycerol and fatty acids
(ii) enzyme amylase hydrolyses starch (undigested in the mouth) into maltose
(iii) enzyme trypsin hydrolyses peptone and polypeptide (protein from stomach) into peptides
- digestion of fats starts in duodenum

(4) Ileum
- the rest of small intestine after the duodenum is the ileum
- walls of ileum contain many intestinal glands which secrete intestinal juice
- intestinal juice is alkaline and contains enzymes to complete the digestion of carbohydrates, proteins and lipids
- end products of digestion of carbohydrate, protein and lipid will be absorbed by the villi in the ileum. Hence, the two processes that occur in the ileum is digestion and absorption

(5) Large intestine
- undigested food passes to large intestine
- semi-solid waste travels along the large intestine and expelled through anus

ABSORPTION OF DIGESTED FOOD
- in the ileum, two processes occur which are digestion and absorption
- process of digestion is completed in the ileum to produce simple sugars (glucose, fructose and galactose), amino acids, glycerol and fatty acids
- process of absorption also occurs in the ileum to absorb the products of digestion into the blood capillaries and to be used by the cells in the body
- products of digestion are absorbed into the body by small finger-like projections called villi in the walls of the small intestine. Each villus contains a network of blood capillaries and a lymphatic vessel called lacteal in the centre of villus

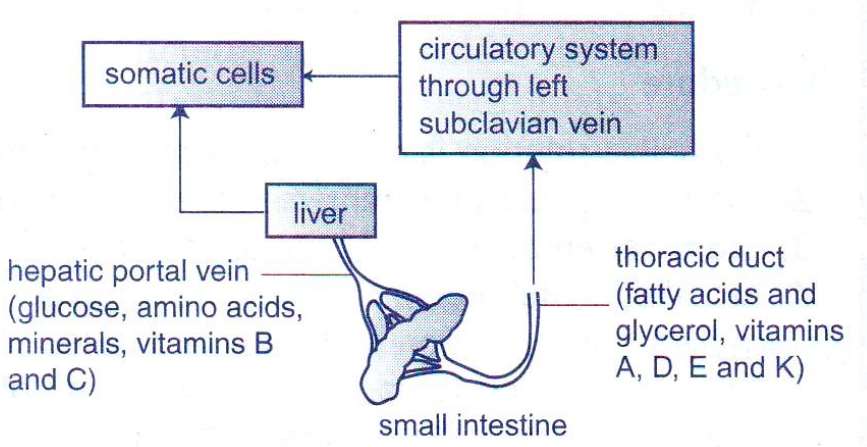
Adaptation of small intestine to aid absorption:
it is long and coiled to increase the surface area for absorption
lining of intestine is greatly folded to increase the surface area for absorption
epithelial cells lining the villus is very thin to facilitate diffusion of digested food
many villi and microvilli to increase surface area for absorption
villus has a network of blood capillaries to transport the digested food that has been absorbed
villus has a lacteal (lymphatic vessel) to transport glycerol and fatty acids



- blood capillaries and lacteal at the villus absorb different digested food
- blood capillaries at the villus absorb glucose (simple sugar), amino acids, minerals, vitamins B and C by diffusion through the epithelium of villus
- these substances are carried by hepatic portal vein to the liver and then distributed to the body cells by circulatory system
- products of fats digestion eg. glycerol and fatty acids as well as vitamins A, D, E and K are absorbed into the lacteal of villus
- glycerol and fatty acids diffuse across the thin epithelium of villus and into the lacteal. Once inside the lacteal, they recombine to form fat droplets
- fat droplets and vitamins A, D, E and K in the lacteals are carried out of the ileum by a larger lymphatic vessel called thoracic duct. From the ileum, thoracic duct carries the contents of lacteal into the bloodstream via the left shoulder vein (left subclavion vein) and is then distributed to the body cells by the circulatory system

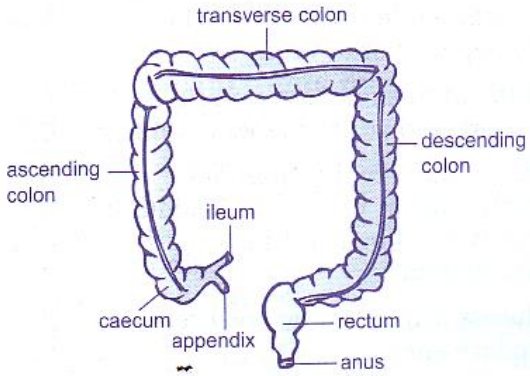
Transport of nutrients by circulatory system

- glucose, amino acids, minerals, vitamins B and C are absorbed into the blood capillaries of villus and carried out of small intestine to the liver by hepatic portal vein
- from the liver, the food molecules that are absorbed are transported away to all the cells in the by circulatory system
- glycerol, fatty acids, vitamins A, D, E and K are absorbed into the lacteal of villus and transported out of the small intestine by the thoracic duct (lymphatic vessel) to the lymphatic system. At the left shoulder, the thoracic duct joins the left subclavian vein, and empties the contents in the lymphatic vessel into the bloodstream
- fat droplets and vitamins A, D, E and K are then transported to all the cells in the body via the circulatory system



Formation of faeces and defaecation

- large intestine consists of caecum (which has the appendix at the tip), colon and rectum which ends at the anus



- fluid food substances that pass from the small intestine into the large intestine are the undigested food residue that has not been absorbed in the ileum
- undigested food residue consists of cellulose, fibres, excretory products eg. bile pigment, bacteria and dead cells
- these food materials are toxic and have to remove from the body
- undigested food residue passes into the caecum of large intestine by peristalsis and then into the colon
- water is absorbed from the undigested food residue, causing it to become more solid as it passes through the colon
- when it reaches the rectum, it has harden into a semi-solid material called faeces. The faeces is kept temporary in the rectum
- when full, the muscular walls of rectum contract to force out the faeces through the anus by defaecation
- defaecation is important for the removal of toxic substances in the undigested food residues from the body. It helps in the movement of bowel and prevents distension of rectum. In fact, it encourages and stimulates the process of peristalsis in the large intestine

PRACTISING GOOD EATING HABItS

- A balanced diet gives us different nutrients for our body needs
- Eat variety of food get different combination of nutrients
- Eat in moderation

- Avoid junk food, salt and cholesterol

DISTRIBUTION OF FOOD FOR NEEDY

- MERCY Malaysia has distributed food, clothing, blankets to people affected by natural and man-made disasters in various parts of the world
- Muslims distribute to the poor and needy during Hari Raya Korban
- Non- muslims distribute food to underprivileged at old folk's homes or orphanages during festival celebrations

CULTURAL PRACTICES AND RELIGIOUS BELIEF

- Malaysia is a multi- ethnic, multi- religious nation
- Tolerance and respect are two vital value should be borne in our mind
- Avoid misunderstanding and friction among various religious groups