INTRODUCTION

- **Nutrition may be defined as the science of food and its relationship to health. It is concerned primarily with the part played by nutrients in body growth, development and maintenance .**
- **The word nutrient or "food factor" is used for specific dietary constituents such as proteins, vitamins and minerals. Dietetics is the practical application of the principles of nutrition; it includes the planning of meals for the well and the sick. Good nutrition means "maintaining a nutritional status that enables us to grow well and enjoy good health."**

- **Protein, carbohydrate and fat had been recognized early in the 19th century as energy-yielding foods and much attention was paid to their metabolism and contribution to energy requirements.**

CLASSIFICATION OF FOODS

- ***Classification by origin:***

- Foods of animal origin

- Foods of vegetable origin

- ***Classification by chemical composition:***

- Proteins

- **Fats**
- **Carbohydrates**
- **Vitamins**
- **Minerals**

CLASSIFICATION BY PREDOMINANT FUNCTION

- **Body building foods:**
- **-meat, milk, poultry, fish, eggs, pulses etc**

- **Energy giving foods:**
- **-cereals, sugars, fats, oils etc.**

- **Protective foods:**
- **-vegetables, fruits, milk, etc**

NUTRIENTS

- **Organic and inorganic complexes contained in food are called nutrients. They are broadly divided in to:**
- **Macronutrients:**
- **-proteins**
- **-fats**
- **-carbohydrates**

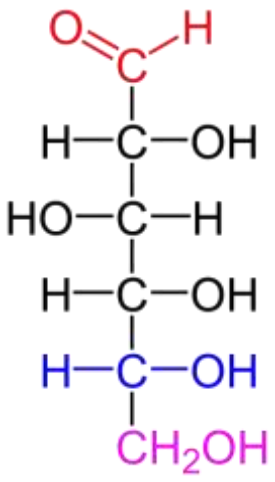
- **Micronutrients:**
- **-vitamins**
- **-minerals**

Carbohydrate

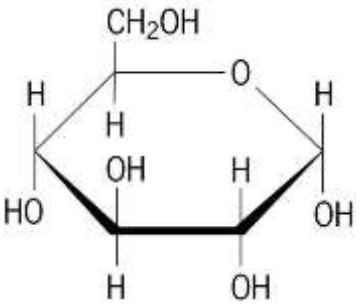
A **carbohydrate** is a large biological molecule, or macromolecule, consisting of carbon (C), hydrogen (H), and oxygen (O) atoms, usually with a hydrogen: oxygen atom ratio of 2:1 (as in water); in other words, with the empirical formula $C_m(H_2O)_n$ (where *m* could be different from *n*). EX D-Glucose $C_6H_{12}O_6$

For example, deoxyribose, a sugar component of DNA, has the empirical formula $C_5H_{10}O_4$.

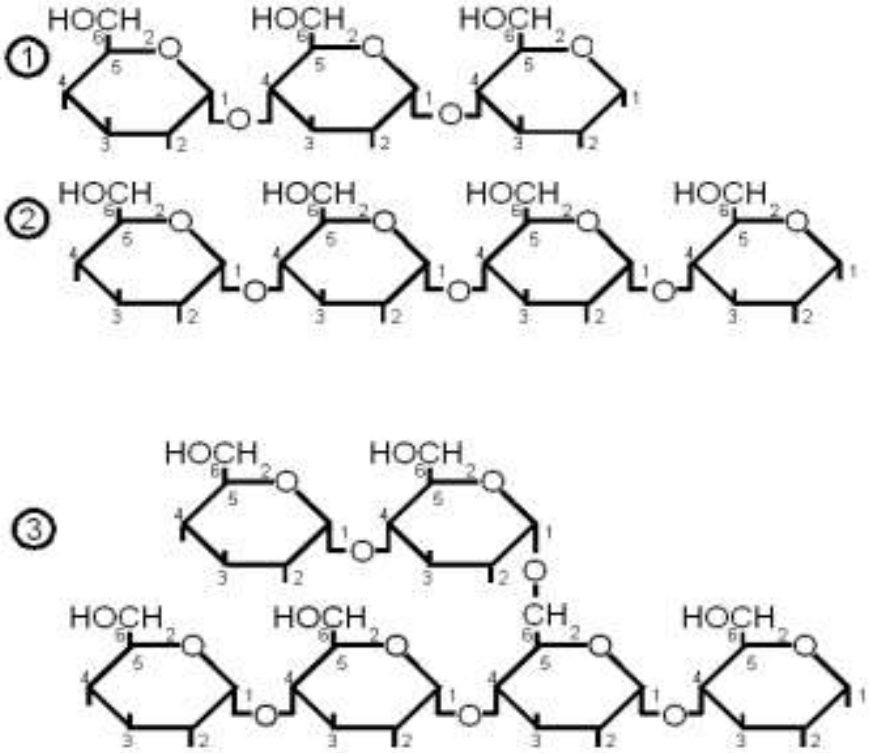
- **Four chemical groups**:
- **Monosaccharides:** are the simplest carbohydrates in that they cannot be hydrolyzed to smaller carbohydrates. Examples: glucose and fructose.
- **Disaccharides:** two joined monosaccharides are called a disaccharide and these are the simplest polysaccharides. Examples: Lactose, a disaccharide composed of one D-galactose molecule and one D-glucose molecule, The systematic name for lactose is *O*-β-D-galactopyranosyl-(1→4)-D-glucopyranose.
- **Oligosaccharide:** is a saccharide polymer containing a small number (typically three to nine) of simple sugars (mono saccharides). Ex: Fructo-oligosaccharides, Galacto-oligosaccharides etc.
- **Polysaccharides:** serve for the storage of energy (e.g., starch and glycogen), and as structural components (e.g., cellulose in plants and chitin in arthropods).



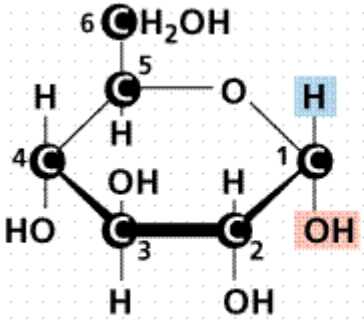
D-Glucose



D-Glucose in ring form

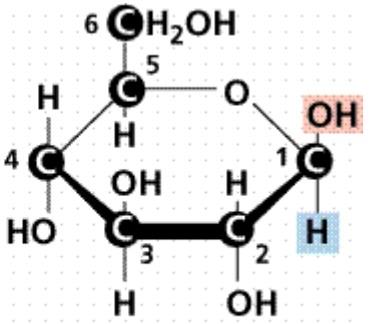


Oligosaccharide in ring form



(c)α-Glucose

or



(d)β-Glucose

What happens if we don't get enough carbohydrate?

- Eating too little carbohydrate may lead to low blood sugar levels – called 'hypoglycaemia', leaving you feeling weak and light headed.
- It can also affect concentration as your brain needs a good supply of fuel to think and learn. Hypoglycaemia is a particular risk for people with diabetes and very active sports People.
- If we eat too little carbohydrate our body will begin to use up some stored fat but quickly moves on to burning protein tissue such as in the heart and muscles.

How are carbohydrates used for energy?

- We break down most carbohydrates in the gut and absorb them into our blood stream as their individual sugar units. Simple carbohydrates usually digest
- quickly giving a rapid rise in blood sugar. Complex carbohydrates take longer to break down into their individual sugar units before they can be absorbed,
- resulting in a slower rise in our blood sugar levels.
- Sugar in the blood is carried into cells such as the muscles and brain with the help of the hormone insulin. We convert any sugar the cells do not need immediately from glucose to glycogen and store it in the liver and muscles for use at a later date. When the stores are full we covert any excess to body fat.

How much carbohydrate should we eat?

- Half of our energy intake should come from carbohydrate; we should aim to make 'starchy' carbohydrates the base and bulk for each meal and snack.
- Starchy foods are a good source of energy and fibre and also contain calcium, iron and B vitamins. Choose wholegrain starchy foods as they contain more nutrients.
- Sugary foods and drinks generally do not contain many other nutrients so have them occasionally in small amounts, preferably after a fiber rich meal.

Aren’t carbohydrates fattening?

- We get energy from carbohydrates, protein, fat and alcohol in our diet.
- Any extra (unneeded) energy we take in will be converted to fat no matter what the source.
- Sometimes people think starchy foods are fattening however, the same amount (in weight) of carbohydrate contains less than half the calories of fat.
- Studies have also shown carbohydrates are better at satisfying our hunger.

CARBOHYDRATE

- **Carbohydrate is the main source of energy, providing 4 Kcals per one gram Carbohydrate is also essential for the oxidation of fats and for the synthesis of certain non-essential amino acids**

Sources of carbohydrates

- **There are three main sources of carbohydrate, viz. starches, sugar and cellulose.**
- **The carbohydrate reserve (glycogen) of a human adult is about 500g. This reserve is rapidly exhausted when a man is fasting. If the dietary carbohydrates do not meet the energy needs of the body, protein and glycerol from dietary and endogenous sources are used by the body to maintain glucose homeostasis.**

Can 'low-carbohydrate' diets help with weight loss?

- 'Low-carbohydrate' diets are sometimes used for weight loss. In the short term they can lead to side effects such as constipation, headache, bad breath and nausea.
- In the longer term, cutting out any food group can be bad for health because you risk missing out on vital nutrients.
- Low-carbohydrate diets tend to be high in fat.
- Eating a high-fat diet (especially one rich in saturated fat from foods such as meat, cheese, cream and butter) could increase the chances of developing heart disease.
- Low -carbohydrate diets may also restrict the amount of fruit, vegetables and fibre, all of which are vital for good health, including reducing cancer risk.
- There is more research needed into how safe or effective low-carbohydrate diets are and following a low-carbohydrate diet does not seem to help people lose weight and keep it off.

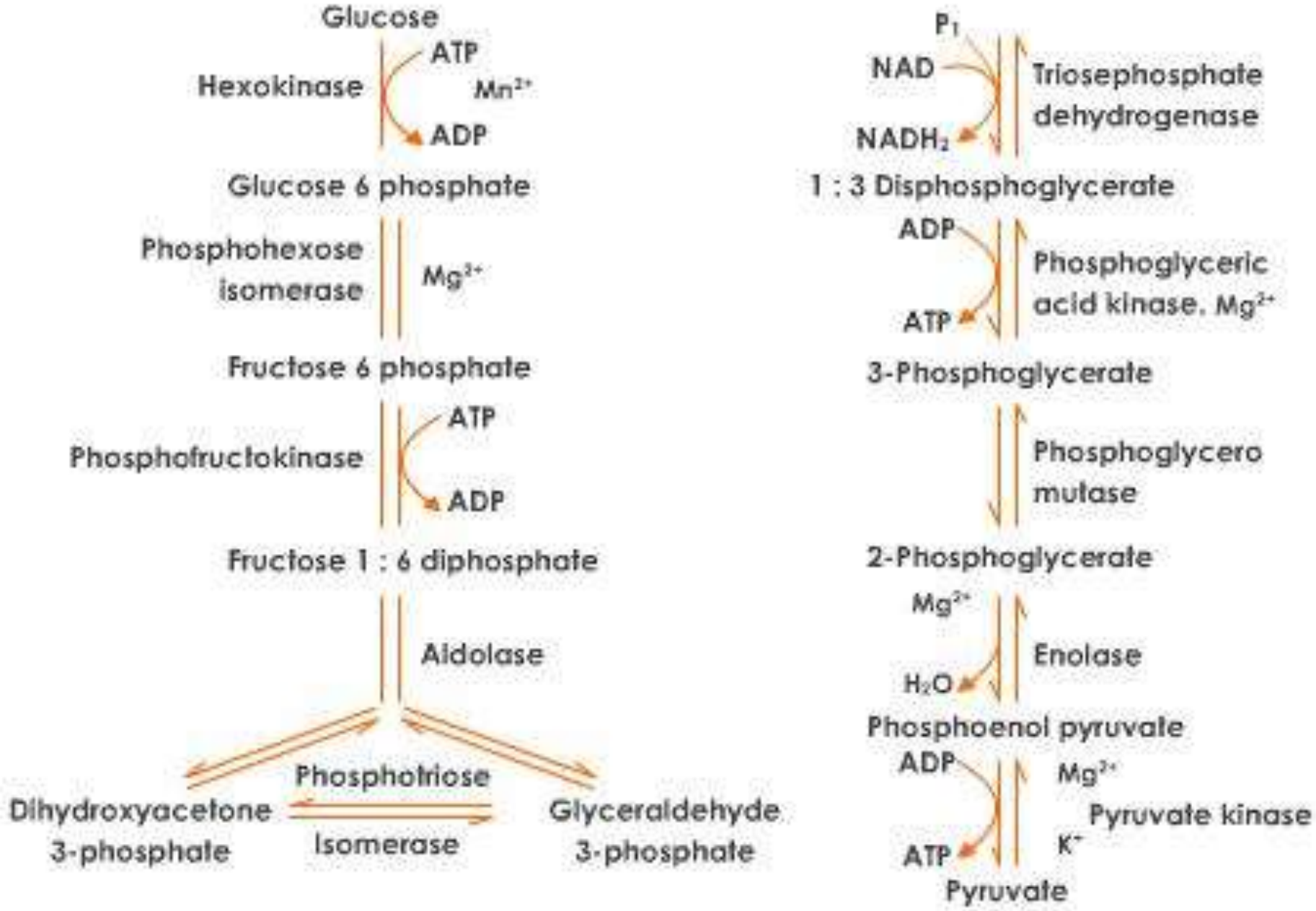
What does the Glycaemic Index of carbohydrates mean?

- Different carbohydrate containing foods are digested and absorbed at different rates. The Glycaemic Index (GI) is used to identify which carbohydrates are quickly broken down to glucose (high GI) and which are slowly broken down (low GI).
- A food with a high GI (e.g white bread, crisps and carrots) will cause a fast rise in your blood sugar levels followed by a rapid fall.
- A food with a low to moderate GI (e.g. wholemeal pasta, oats, beans and yoghurt) will cause a slower rise and fall.
- GI is a well known dieting tool, however it can be restricting as it measures foods per 50g of carbohydrate provided and not by portion size, and so foods like carrots are included in the high GI list along with other important fruits and vegetables.

What about Glycaemic Load?

Glycaemic Load (GL) is a sum which takes into account the GI of a food and the available carbohydrate content in a serving of that food. Like Gl the higher the GL, the faster the expected rise in blood sugar.

- For example, carrots have a high GI but a low GL. This is because GI is based on the rise caused by consuming 50g of carbohydrate from any food.
- So to get 50g of carbohydrate from carrots you would need to eat around 700g of carrots– about five whole carrots to cause this blood sugar rise.
- As a portion of carrots eaten is much smaller at 60g rather than 700g, carrots can be considered as having a low GL and therefore can be included in your diet.



Glycolysis: Pathway of degradation

Summary

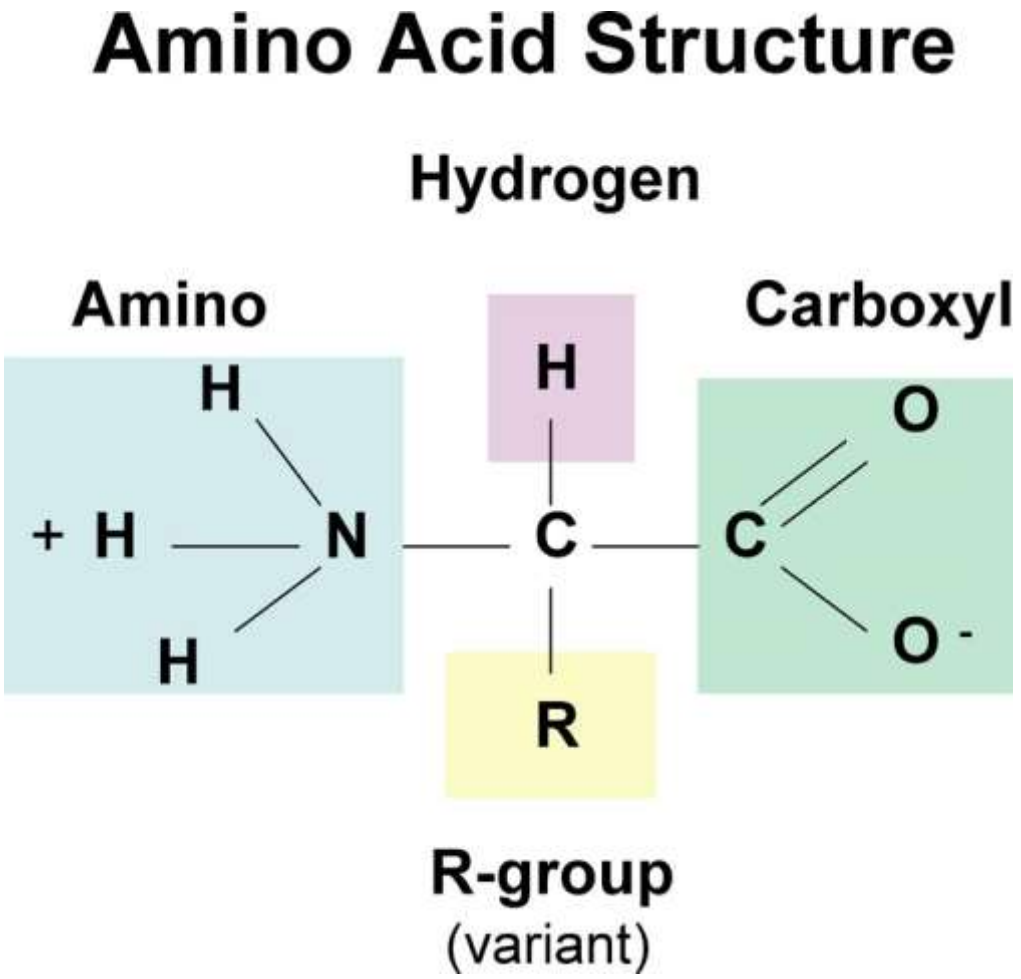
- Carbohydrates are an important part of your diet and should make up half of each meal. Whenever possible choose wholegrain 'starchy' carbohydrates
- As they contain additional important 'nutrients' for the body. Carbohydrates are a healthy filling choice; they are better at satisfying our hunger than fatty/sugary foods which also contain more calories.
- So forget those myths about carbohydrates being bad and don't be tempted to cut out those slow releasing carbohydrates.

Proteins

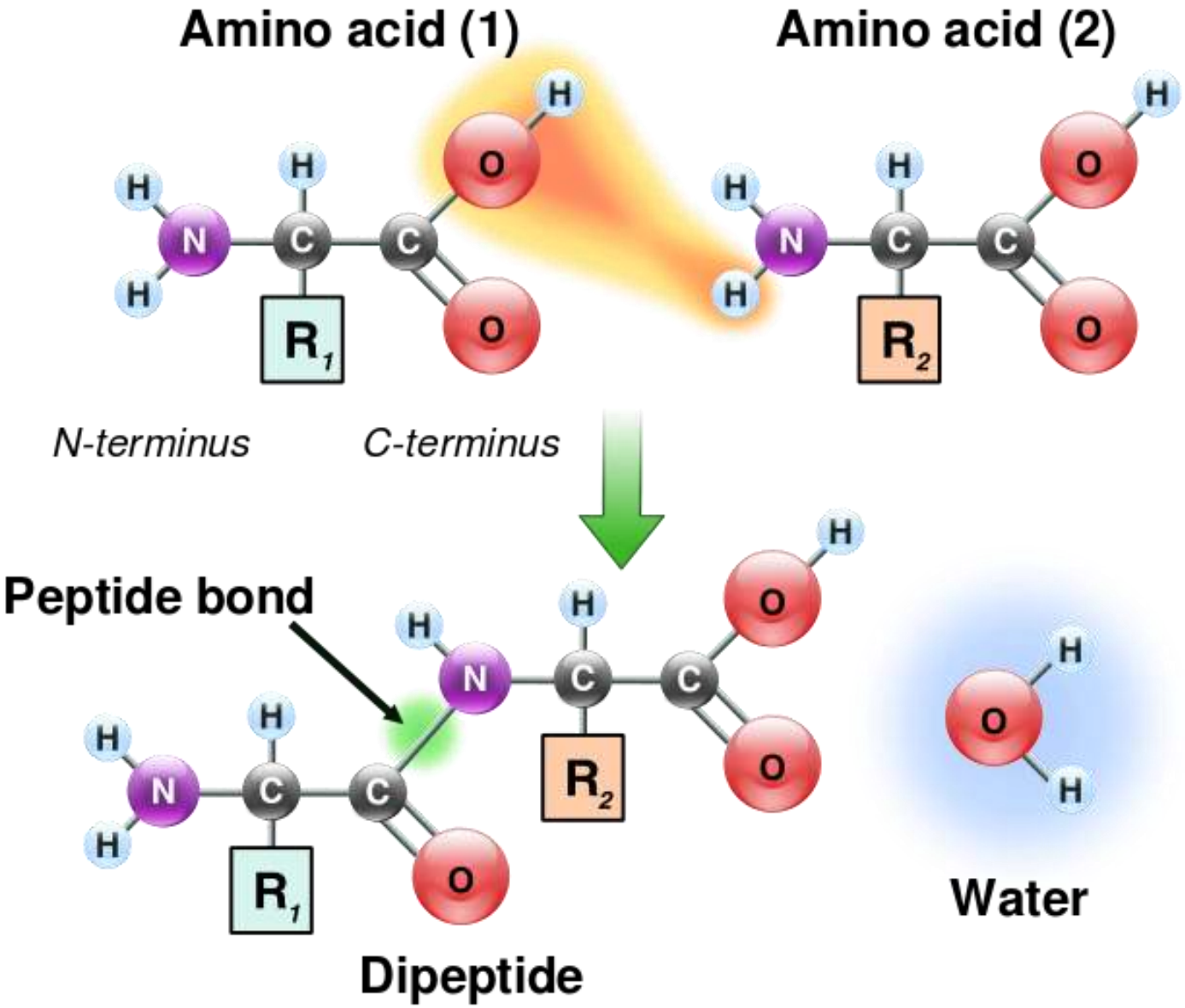
- Protein is the main tissue builder and part of every cell in the body.
- proteins help to: make hemoglobin in the blood that carries oxygen to the cells;
- form anti-bodies that fight infection;
- supply nitrogen for DNA and RNA genetic material;
- and supply energy.

Proteins

- Proteins are the short or long chain of amino acids.
- Among the 20 or more amino acids, the human body is unable to synthesize 8, therefore, these amino acids are called essential amino acids.
- A food containing protein may be of poor biological value if it is deficient in one or more of the 8 essential amino acids: lysine, tryptophan, methionine, leucine, isoleucine, phenylalanine, valine, and threonine.
- Proteins of animal origin have the highest biological value because they contain a greater amount of the essential amino acids.
- Foods with the best quality protein are listed in diminishing quality order: whole eggs, milk, soybeans, meats, vegetables, and grains.



Research has shown that about 20% of a human body is made up of proteins.


Amino acid (1)
Amino acid (2)
N-terminus
C-terminus
Peptide bond
Dipeptide
Water

PROTEINS

- **Proteins are complex organic nitrogenous compounds.**
- **They also contain sulfur and i some cases phosphorous and iron.**
- **Proteins are made of monomers called amino acids.**
- **There are about 20 different aminoacids which r found in human body.**
- **Of this 8 aa are termed “essential” as they are not synthesized in human body and must be obtained from dietary protiens.**

Functions of Proteins

- **Body building**
- **Repair and maintenance of body tissues**
- **Maintenance of osmotic pressure**
- **Synthesis of bioactive substances and other vital molecules**

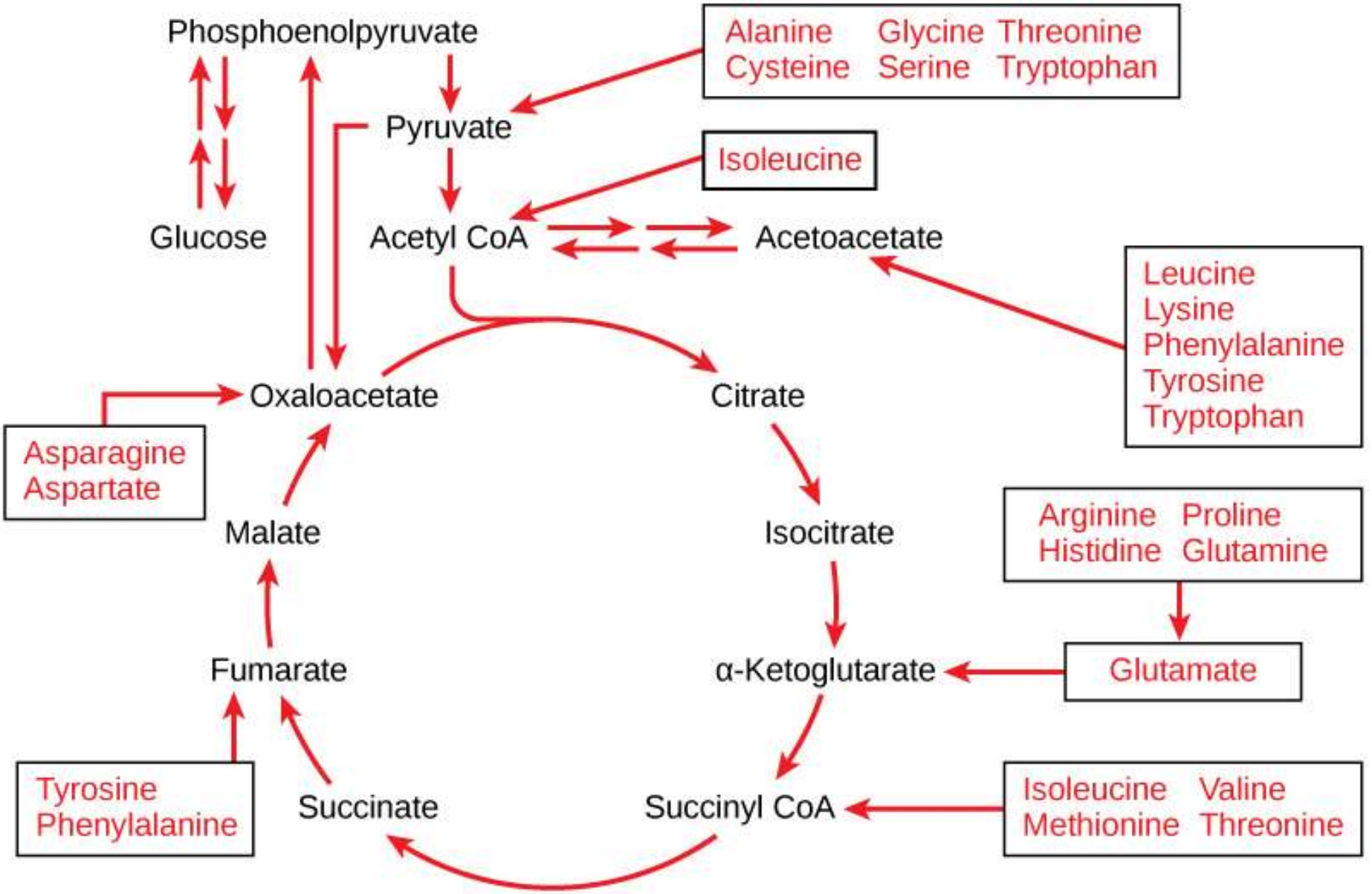
Evaluation of proteins

The parameters used for net protein evaluation are:

- **Biological value**
- **Digestibility coefficient**
- **Protein efficiency ratio**
- **Net protein utilization (NPU)**

Assessment of Protein nutrition status

- **Protein nutrition status is measured by Serum Albumin Concentration.**
- **It should be more than 3.5 g/dl.**
- **Less than 3.5 g/dl shows mild malnutrition.**
- **Less than 3.0 g/dl shows severe malnutrition.**



The carbon skeletons of certain amino acids (indicated in boxes) derived from proteins can feed into the citric acid cycle. (credit: modification of work by Mikael Häggström)

Fats/Lipids

- Fats are concentrated sources of energy because they give twice as much energy as either carbohydrates or protein on a weight basis.
- The functions of fats are to: make up part of the structure of cells, form a protective cushion and heat insulation around vital organs, carry fat soluble vitamins, and provide a reserve storage for energy.
- Three unsaturated fatty acids which are essential include: linoleic, linolinic, and arachidonic and have 2, 3, and 4 double bonds respectively.
- Saturated fats, along with cholesterol, have been implicated in arteriosclerosis, "hardening of the arteries".
- For this reason, the diet should be decreased in saturated fats (animal) and increased in unsaturated fat (vegetable).

FAT

- **Most of the body fat (99 per cent) in the adipose tissue is in the form of triglycerides, in normal human subjects, adipose tissue constitutes between 10 and 15 per cent of body weight. One kilogram of adipose tissue corresponds to 7700 kcal of energy.**

Fats yield fatty acids and glycerol on hydrolysis

- **Fatty acid content of different fats (in per cent)**

Fats	Saturated fatty acids	Monounsaturated fatty acids	Polyunsaturated fatty acids
Coconut oil	92	6	2
Palm oil	46	44	10
Cotton seed oil	25	25	50
Groundnut oil	19	50	31
Safflower oil	10	15	75
Sunflower oil	8	27	65
Corn oil	8	27	65
Soya bean oil	14	24	62
Butter	60	37	3

Essential fatty acids are those that cannot be synthesized by humans

- ***Dietary sources of EFA***
- ***Linoleic acid***
- **Sunflower oil Corn oil Soya bean oil Sesame oil Groundnut oil Mustard oil Palm oil Coconut oil**
- ***Arachidonic acid***
- **Meat, eggs, milk**
- ***Linolenic acid***
- **Soya bean oil, Leafy greens**

Functions of fats

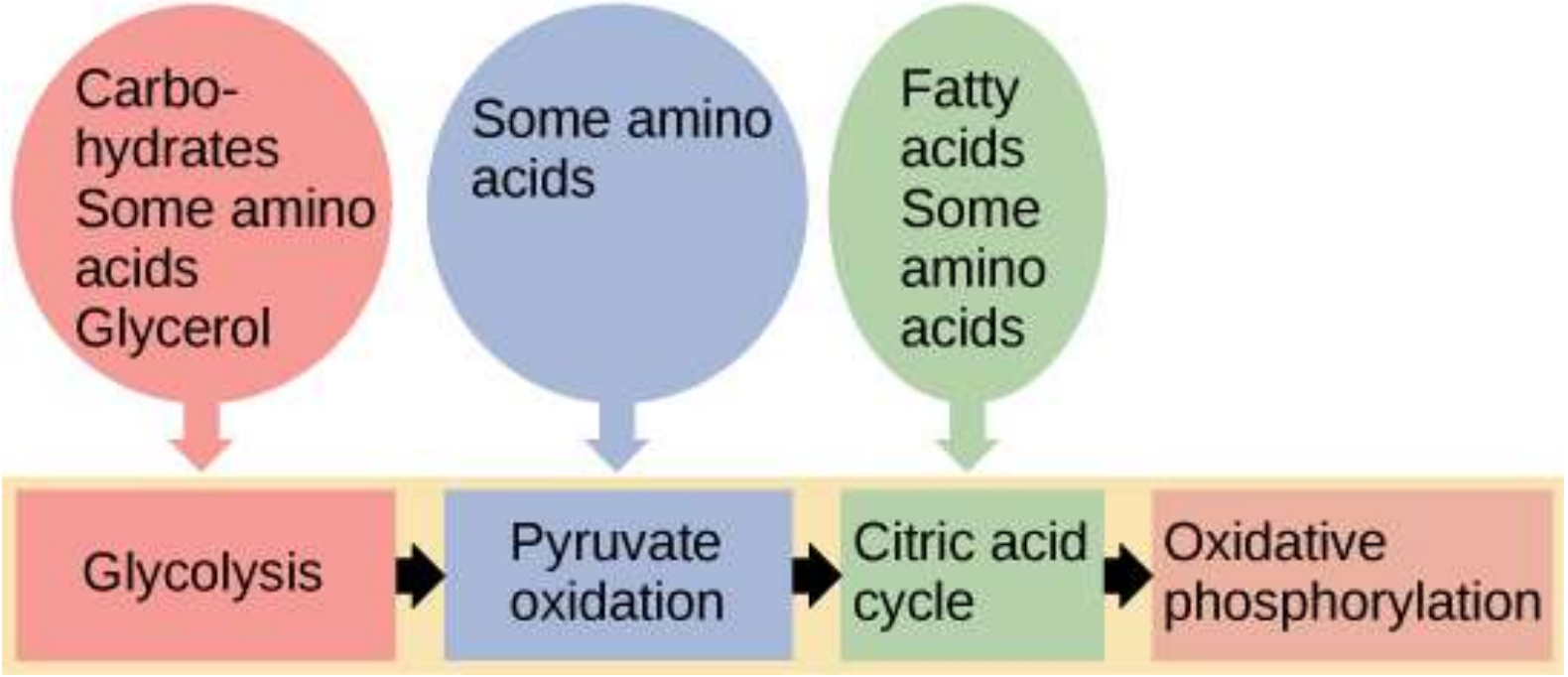
- **They are high energy foods, providing as much as 9 kcal for every gram.**
- **Fats serve as vehicles for fat-soluble vitamins**
- **Fats in the body support viscera such as heart, kidney and intestine; and fat beneath the skin provides insulation against cold.**

The “non-calorie” roles of fat

- **vegetable fats are rich sources of essential fatty acids which are needed by the body for growth, structural integrity of the cell membrane and decreased platelet adhesiveness.**
- **Diets rich in EFA have been reported to reduce serum cholesterol and low-density lipoproteins.**
- **Polyunsaturated fatty acids are precursors of prostaglandins.**

Fat requirements

- **In developed countries dietary fats provide 30 to 40 per cent of total energy intake. The WHO Expert committee on Prevention of Coronary Heart Disease has recommended only 20 to 30 per cent of total dietary energy to be provided by fats. At least 50 per cent of fat intake should consist of vegetable oils rich in essential fatty acids.**



Glycogen from the liver and muscles, hydrolyzed into glucose-1-phosphate, together with fats and proteins, can feed into the catabolic pathways for carbohydrates

Minerals

- **Minerals:**
- The minerals in foods do not contribute directly to energy needs but are important as body regulators and as essential constituents in many vital substances within the body.
- A MINERAL is rather loosely defined as any element not normally a part of the structures of carbohydrates, proteins, and fats. More than 50 elements are found in the human body.
- About 25 elements have been found to be essential, since a deficiency produces specific deficiency symptoms.
- **Major Minerals Include:** calcium, phosphorus, iron, sodium, potassium, and chloride ions.
- **Other Essential Minerals Include:** copper, cobalt, manganese, zinc, magnesium, fluorine, and iodine.

The recommended daily requirements of minerals for men, women are shown in the table below

Minerals	Men	Women	Sources
Calcium	700mg	700mg	milk, cheese and other dairy foods green leafy vegetables, such as broccoli, cabbage and okra, but not spinach, soya beans, tofu, soya drinks with added calcium, nuts, bread and anything made with fortified flour, fish where you eat the bones, such as sardines and pilchards
Iodine	0.14mg	0.14mg	sea fish and shellfish, cereals, grains
Iron	8.7mg	14.8mg	liver, meat, beans, nuts, dried fruit, such as dried apricots, wholegrains, such as brown rice, fortified breakfast cereals, soybean flour, most dark-green leafy vegetables, such as watercress and curly kale
Beta-carotene	7mg	7mg	yellow and green (leafy) vegetables, such as spinach, carrots and red peppers, yellow fruit such as mango, melon and apricots
Boron	<6mg	<6mg	green vegetables, fruit, nuts
Chromium	0.025mg	0.025mg	meat, wholegrains, such as wholemeal bread and whole oats, lentils, spices
Cobalt	0.0015mg	0.0015mg	fish, nuts, green leafy vegetables, such as broccoli and spinach, cereals, such as oats
Copper	1.2mg	1.2mg	nuts, shellfish, offal
Magnesium	300mg	270mg	nuts, spinach, bread, fish, meat, dairy foods
Manganese	<0.5mg	<0.5mg	tea, bread, nuts, cereals, green vegetables such as peas and runner beans
Phosphorus	550mg	550mg	red meat, dairy foods, fish, poultry, bread, rice, oats
Potassium	3,500mg	3,500mg	fruit such as bananas, vegetables, pulses, nuts and seeds, milk, fish, shellfish, beef, chicken, turkey, bread
Selenium	0.075mg	0.06mg	brazil nuts, bread, fish, meat, eggs
Sodium chloride (salt)	<6g	<6g	ready meals, meat products, such as bacon, some breakfast cereals, cheese, some tinned vegetables, some bread, savoury snacks
Zinc	9mg	7mg	meat, shellfish, milk, dairy foods, such as cheese, bread, cereal products, such as wheat germ.

Water

- A healthy adult living in a temperate climate should drink 1.5 litres of **water** per day.
- This threshold of drinking water enables to balance water losses and keep one's body properly hydrated.
- Water is a major constituent of our bodies and vital organs.

The 5 functions of water in our body body-water

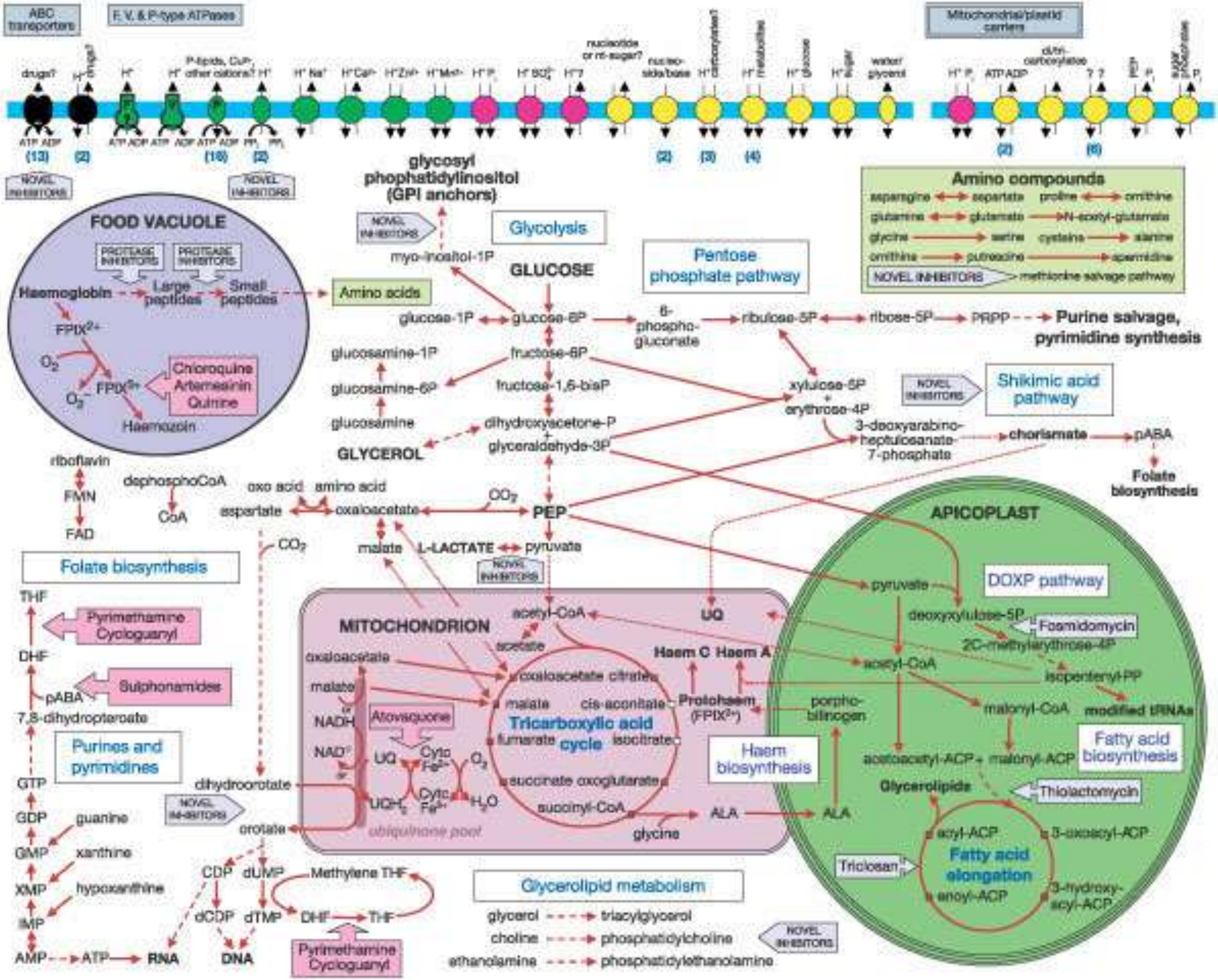
1. Cell life: Water is a carrier, distributing essential nutrients to cells, such as minerals, vitamins and glucose

2. Chemical and metabolic reactions: Water removes waste products including toxins that the organs' cells reject, and removes them through urines and faeces.

3. Transport of nutrients: Water participates in the biochemical break-down of what we eat.

4. Body temperature regulation: Water has a large heat capacity which helps limit changes in body temperature in a warm or a cold environment.
Water allows the body to release heat when ambient temperature is higher than body temperature.

5. Elimination of waste: Water is an effective lubricant around joints. It also acts as a shock absorber for eyes, brain, spinal cord and even for the foetus through amniotic fluid.



ABC transporters
F, V, & P-type ATPases
Mitochondrial/plastid carriers
NOVEL INHIBITORS
glycosyl phophatidylinositol (GPI anchors)
FOOD VACUOLE
PROTEASE INHIBITORS
Haemoglobin
Large peptides
Small peptides
Amino acids
FPIX2+
FPIX3+
Chloroquine Artemesinin Quinine
Haemozoin
Glycolysis
myo-inositol-1P
GLUCOSE
glucose-1P
glucose-6P
fructose-6P
fructose-1,6-bisP
glucosamine-1P
glucosamine-6P
glucosamine
dihydroxyacetone-P + glyceraldehyde-3P
GLYCEROL
Pentose phosphate pathway
6-phospho-gluconate
ribulose-5P
ribose-5P
PRPP
Purine salvage, pyrimidine synthesis
xylulose-5P + erythrose-4P
Shikimic acid pathway
3-deoxyarabino-heptulosonate-7-phosphate
chorismate
pABA
Folate biosynthesis
Amino compounds
asparagine ↔ aspartate
proline ↔ ornithine
glutamine ↔ glutamate → N-acetyl-glutamate
glycine → serine
cysteine → alanine
ornithine → putrescine → spermidine
NOVEL INHIBITORS → methionine salvage pathway
riboflavin
FMN
FAD
dephosphoCoA
CoA
oxo acid
amino acid
aspartate
oxaloacetate
CO_2
PEP
malate
L-LACTATE
pyruvate
Folate biosynthesis
THF
Pyrimethamine Cycloguanyl
DHF
pABA
Sulphonamides
7,8-dihydropteroate
Purines and pyrimidines
GTP
GDP
GMP
XMP
IMP
AMP
ATP
RNA
guanine
xanthine
hypoxanthine
MITOCHONDRION
acetyl-CoA
acetate
oxaloacetate
malate
NADH
NAD+
Atovaquone
UQ
UQH2
Cyto Fe2+
Cyto Fe3+
O_2
H_2O
ubiquinone pool
Tricarboxylic acid cycle
oxaloacetate
citrate
cis-aconitate
isocitrate
oxoglutarate
succinyl-CoA
succinate
fumarate
malate
UQ
Haem C
Haem A
Protohaem (FPIX2+)
Haem biosynthesis
ALA
glycine
porpho-bilinogen
dihydroorotate
orotate
CDP
dCDP
dUMP
dTMP
DNA
Methylene THF
DHF
THF
Pyrimethamine Cycloguanyl
Glycerolipid metabolism
glycerol → triacylglycerol
choline → phosphatidylcholine
ethanolamine → phosphatidylethanolamine
APICOPLAST
pyruvate
DOXP pathway
deoxyxylulose-5P
Fosmidomycin
2C-methylerythrose-4P
isopentenyl-PP
modified tRNAs
acetyl-CoA
malonyl-CoA
acetoacetyl-ACP + malonyl-ACP
Fatty acid biosynthesis
Glycerolipids
Thiolactomycin
acyl-ACP
3-oxoacyl-ACP
Fatty acid elongation
Triclosan
enoyl-ACP
3-hydroxy-acyl-ACP

Food Labels

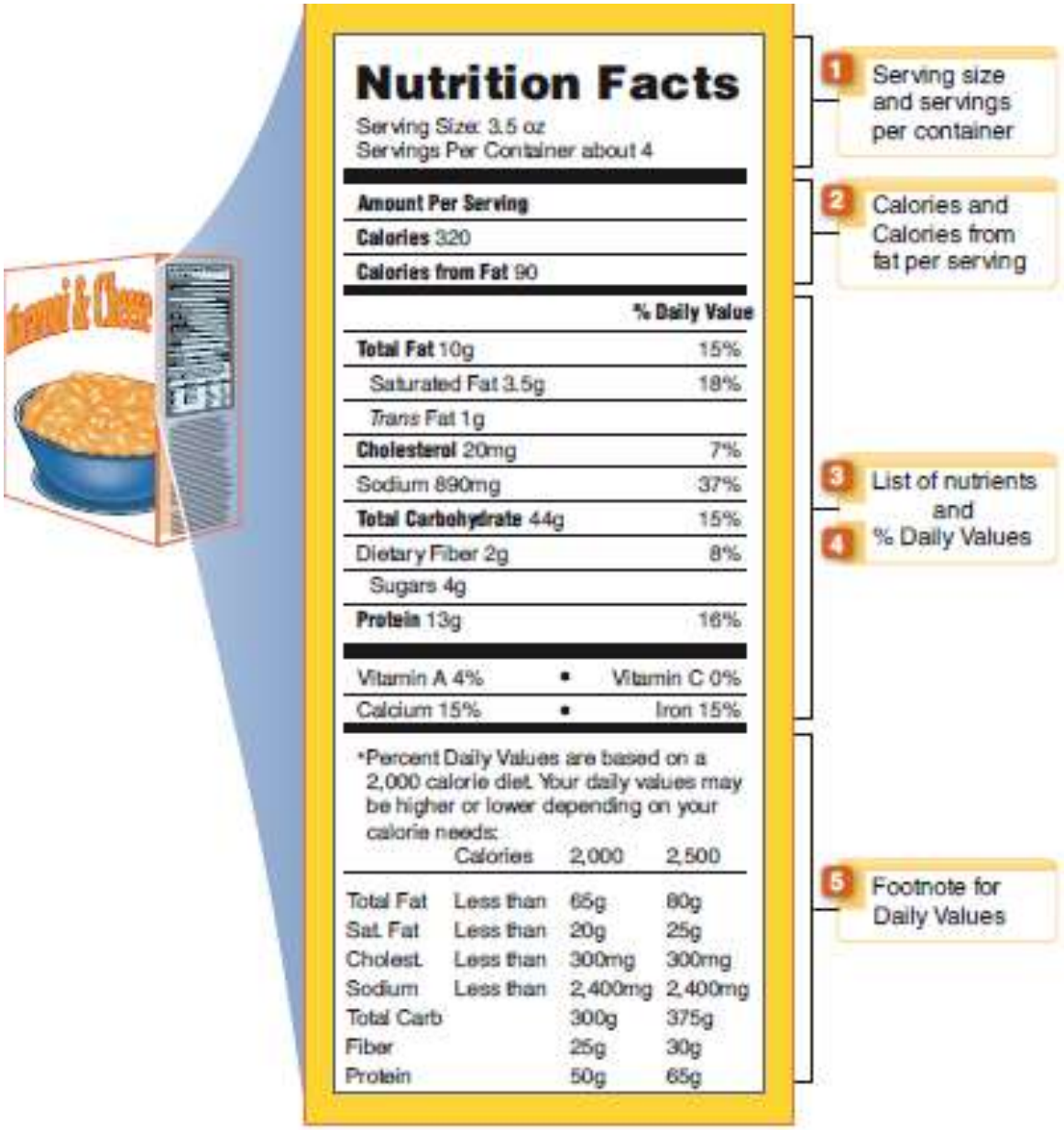
The FDA requires food labels on most products.

These labels must include

Nutrition Facts Panel

The Nutrition Facts Panel contain the nutrition information required by the FDA.

This information can be used in planning a healthful diet.

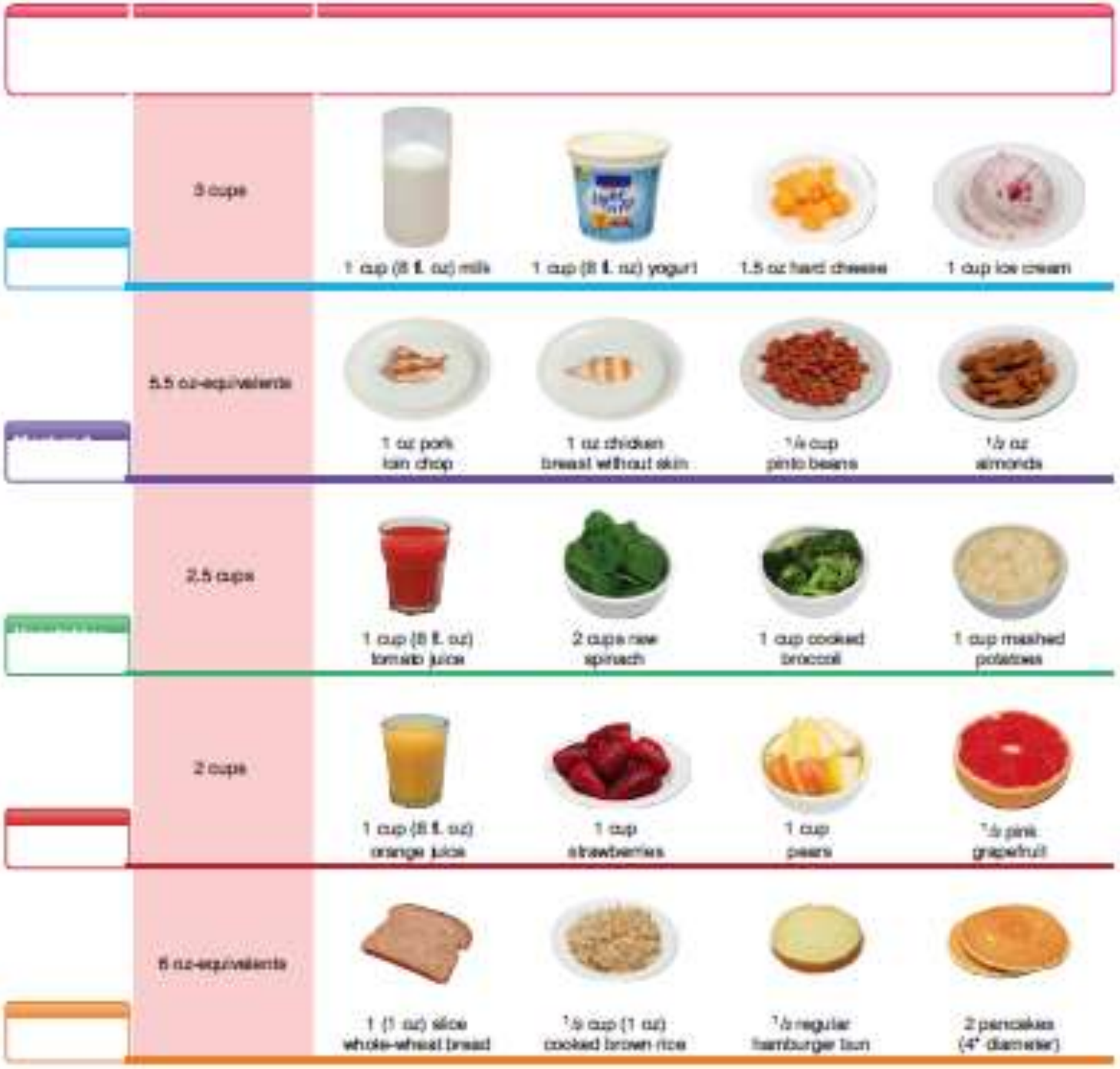


Dietary Guidelines

Nutrition recommendations for Canada and the United Kingdom

- **General guidelines for a healthful diet**
- **Similar to Dietary Guidelines for Americans**

MyPyramid


3 cups
1 cup (8 fl. oz) milk
1 cup (8 fl. oz) yogurt
1.5 oz hard cheese
1 cup ice cream
5.5 oz-equivalents
1 oz pork loin chop
1 oz chicken breast without skin
½ cup pinto beans
½ oz almonds
2.5 cups
1 cup (8 fl. oz) tomato juice
2 cups raw spinach
1 cup cooked broccoli
1 cup mashed potatoes
2 cups
1 cup (8 fl. oz) orange juice
1 cup strawberries
1 cup pears
½ pink grapefruit
6 oz-equivalents
1 (1 oz) slice whole-wheat bread
½ cup (1 oz) cooked brown rice
½ regular hamburger bun
2 pancakes (4" diameter)

THE END