Nutrition
BCH 445
Lectures:1-3

Biochemistry department
Sciences college

Course description

This course is designed to study nutrition via biochemical concepts with emphasis on biochemical and physiological fundamentals of nutrition. The course presents an integrated approach to the roles of protein, fat, carbohydrate, energy, minerals and vitamins in metabolism, and their relationships to nutritional concepts

Reference book

- Nutrition for Health and Health Care 4th Edition by Whitney

Course evaluation

Exam	Marks	Date and time of exam
Quiz 1	05	10th Oct (tues) ,10am
Mid 1	25	24th Oct (tues) ,10am
Quiz 2	05	14th Nov (tues) ,10am
Mid 2	25	28th Nov (tues) ,10am
Final	40	
Total	100	

Introduction

Nutrition is the study of nutrients in food, how the body uses nutrients, and the relationship between diet, health and disease.

Nutrition is the science that interprets the interaction of nutrients and other substances in food in relation to maintenance, growth, reproduction, health and disease of an organism. It includes food intake, absorption, assimilation, biosynthesis, catabolism and excretion

Nutritional science studies how the body breaks food down (catabolism) and repairs and creates cells and tissue (anabolism) - catabolism and anabolism = metabolism. Nutritional science also examines how the body responds to food.

As molecular biology, biochemistry and genetics advance, nutrition has become more focused on the steps of biochemical sequences through which substances inside us and other living organisms are transformed from one form to another - metabolism and metabolic pathways.

Nutrition also focuses on how diseases, conditions and problems can be prevented or lessened with a healthy diet.

In addition, nutrition involves identifying how certain diseases, conditions or problems may be caused by dietary factors, such as poor diet (malnutrition), food allergies, metabolic diseases, etc.

Calories are a measure of the amount of energy in food. Various definitions exist but fall into two broad categories.

- The small calorie or gram calorie (symbol: cal) is the approximate amount of energy needed to raise the temperature of one gram of water by one degree Celsius at a pressure of one atmosphere.
- The large calorie or kilogram calorie (symbol: Cal), also known as the food calorie and similar names, is defined in terms of the kilogram rather than the gram. It is equal to 1000 small calories, 1 kilocalorie (symbol: kcal)

Factors Affecting Nutrition

- Age
- Lifestyle
- Ethnicity, Culture
- Religious Practices
- Economics
- Gender
- Medication

The 10 Signs of Good Nutrition

1. Appropriate Height & Weight
2. Strong Bones
3. Healthy Skin
4. Good Vision
5. Muscle Development
6. Strong Teeth
7. Shiny Hair
8. Healthy Nails
9. Sleeping Soundly
10. Being Active & Alert

Food does much more that satisfy your appetite. It provides nutrients that the body uses for growth and health.

There are five types of nutrients that fall into two broad categories:

- macronutrients and micronutrients.
- Macronutrients, which are required in large amounts, include carbohydrates, proteins and fats.
- In contrast, micronutrients are required in small amounts and include vitamins and minerals. A sixth category includes water, which is essential to life.

They are divided into six classes:

- ✓Carbohydrates (CHO)
- ✓Fats (lipids)
- ✓Proteins
- ✓Vitamins
- ✓Minerals
- ✓Water

The Three Major Functions of Nutrients

1. Provide Energy	Carbohydrates Proteins Lipids (fats and oils)
2. Promote Growth and Development	Proteins Lipids Vitamins Minerals Water
3. Regulate Body Functions	Proteins Lipids Vitamins Minerals Water

❖ Each nutrient is important, but none works alone. For example, carbohydrates, proteins, and fats are necessary for energy, but to provide it, they need the help of vitamins, minerals, and water.

❖ Proteins are essential for building and repairing body tissue, but without vitamins, minerals, and water, they are ineffective.

❖ Foods that contain substantial amounts of nutrients are described as nutritious or nourishing.

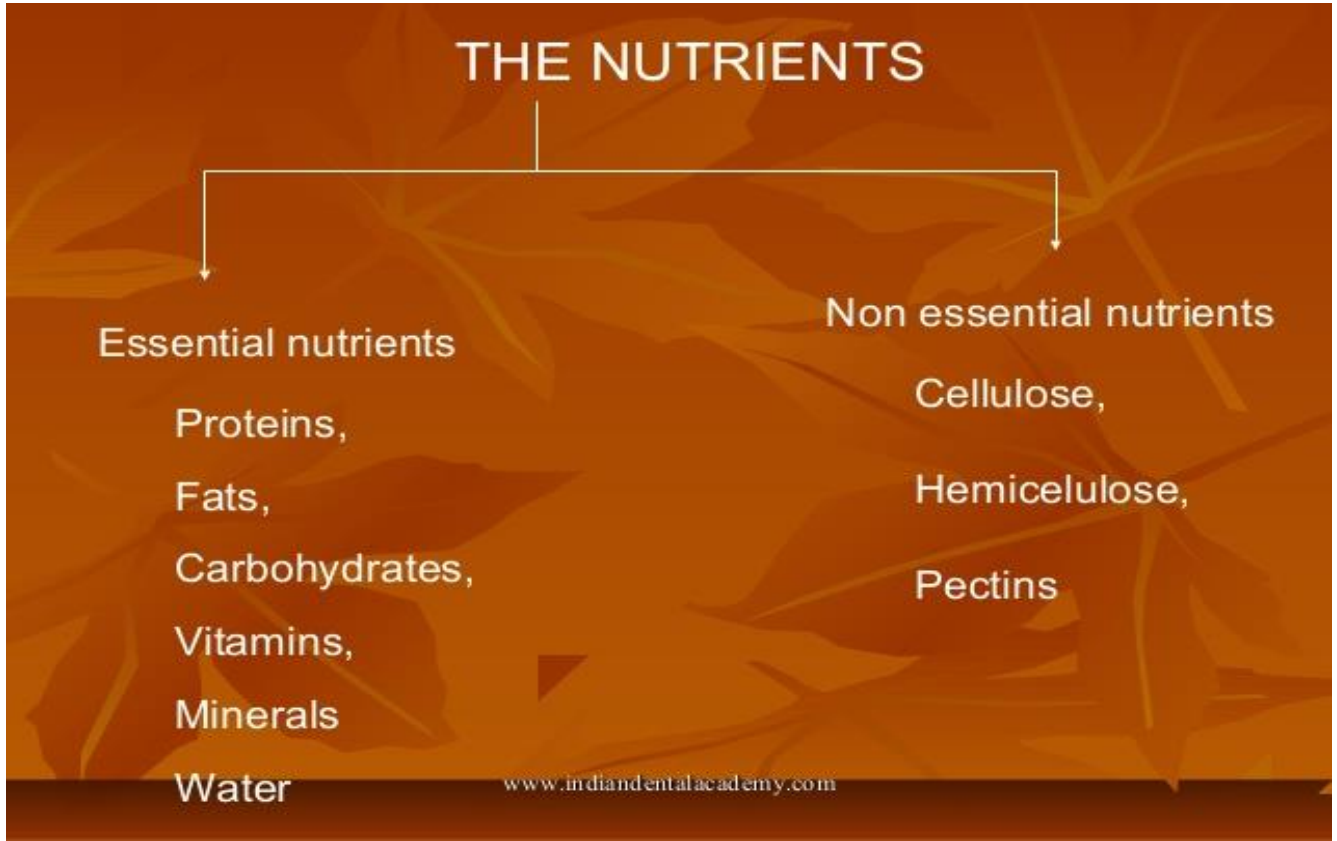
❖ Nourishing: food that containing substances necessary for growth, health, and good condition.

There are several ways to classify the nutrients.

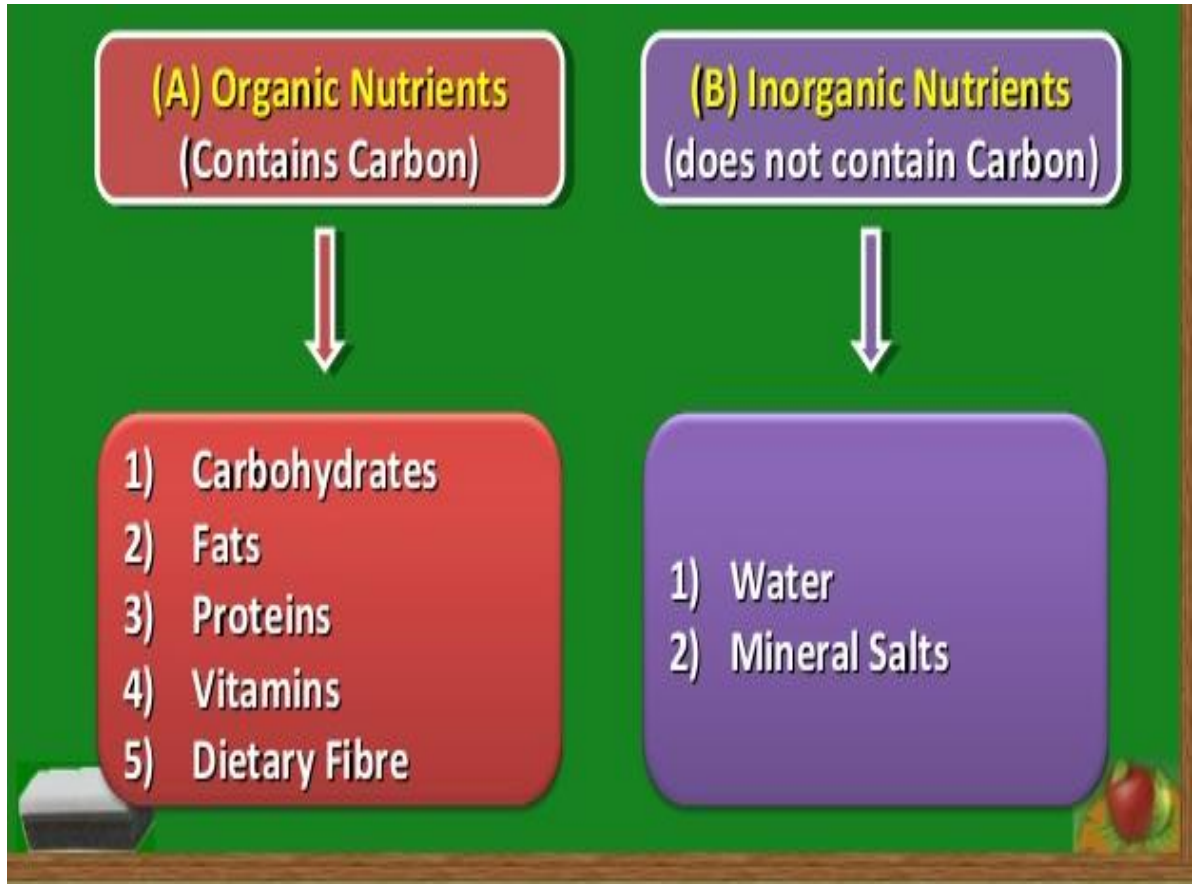
- ❖ Essential or nonessential
- ❖ Organic or inorganic
- ❖ Macronutrient or micronutrient
- ❖ Energy yielding or not

Essential nutrients are any nutrients that body cannot make by it's self, or at least no at much as we need. These are nutrients that the body needs to perform it's basic functions. There are many different essential nutrients and many different ways to obtain them.

Non essential nutrients are nutrients that are made naturally in the body. They can also be absorbed through certain foods. Even though they are referred to as non essential they are still important in maintaining health. If there is a deficiency of ones of these nutrients disease can occur.

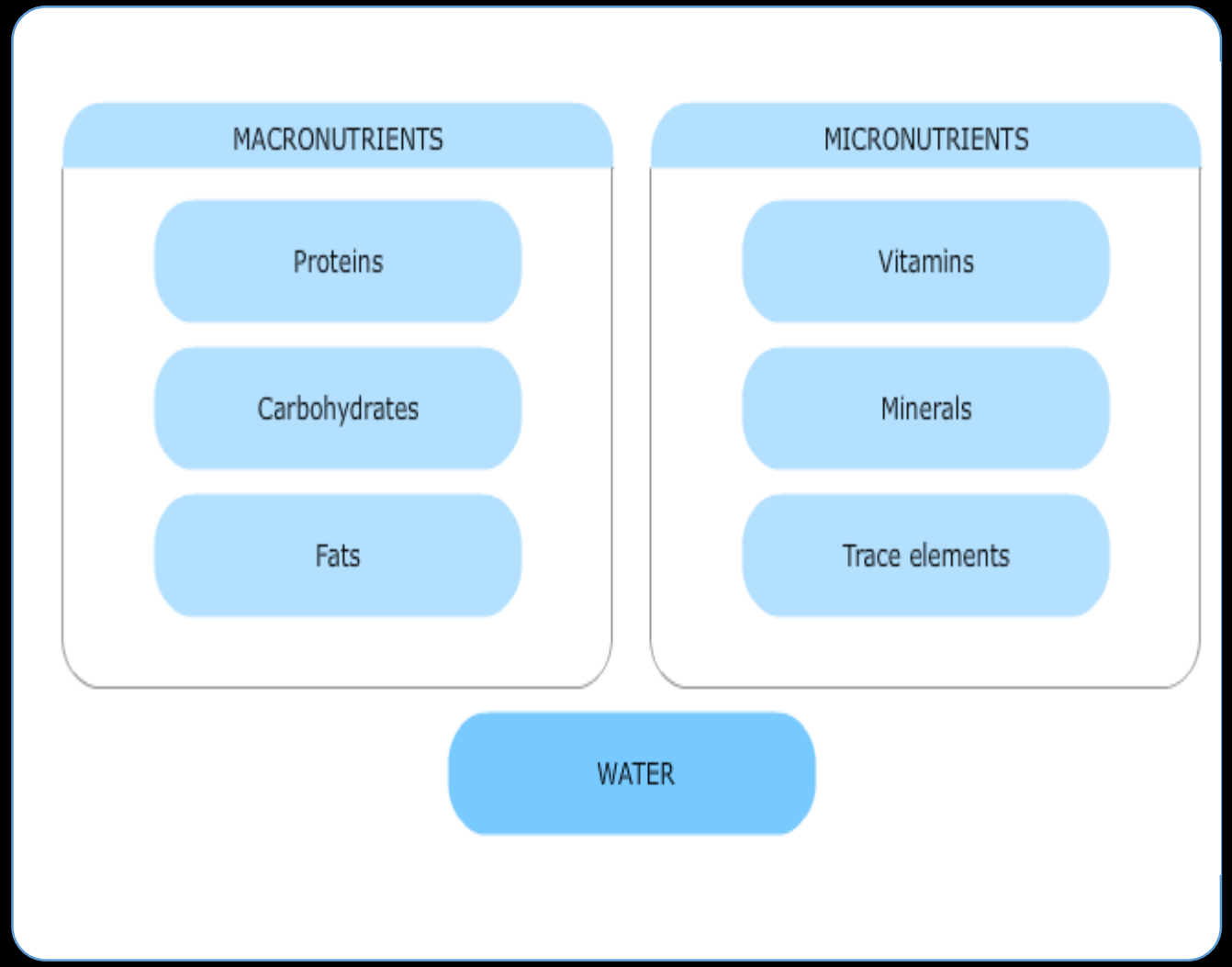


• The presence or absence of carbon is what differentiates organic nutrients from inorganic nutrients. Carbohydrates, lipids, proteins and vitamins have carbon in their structure, making them **organic**. Water and minerals do not, so they are **inorganic**.



- **Macronutrients**: need in relatively large amounts
Carbohydrates, lipids, proteins

- **Micronutrients**: need in relatively small amounts
All other nutrient

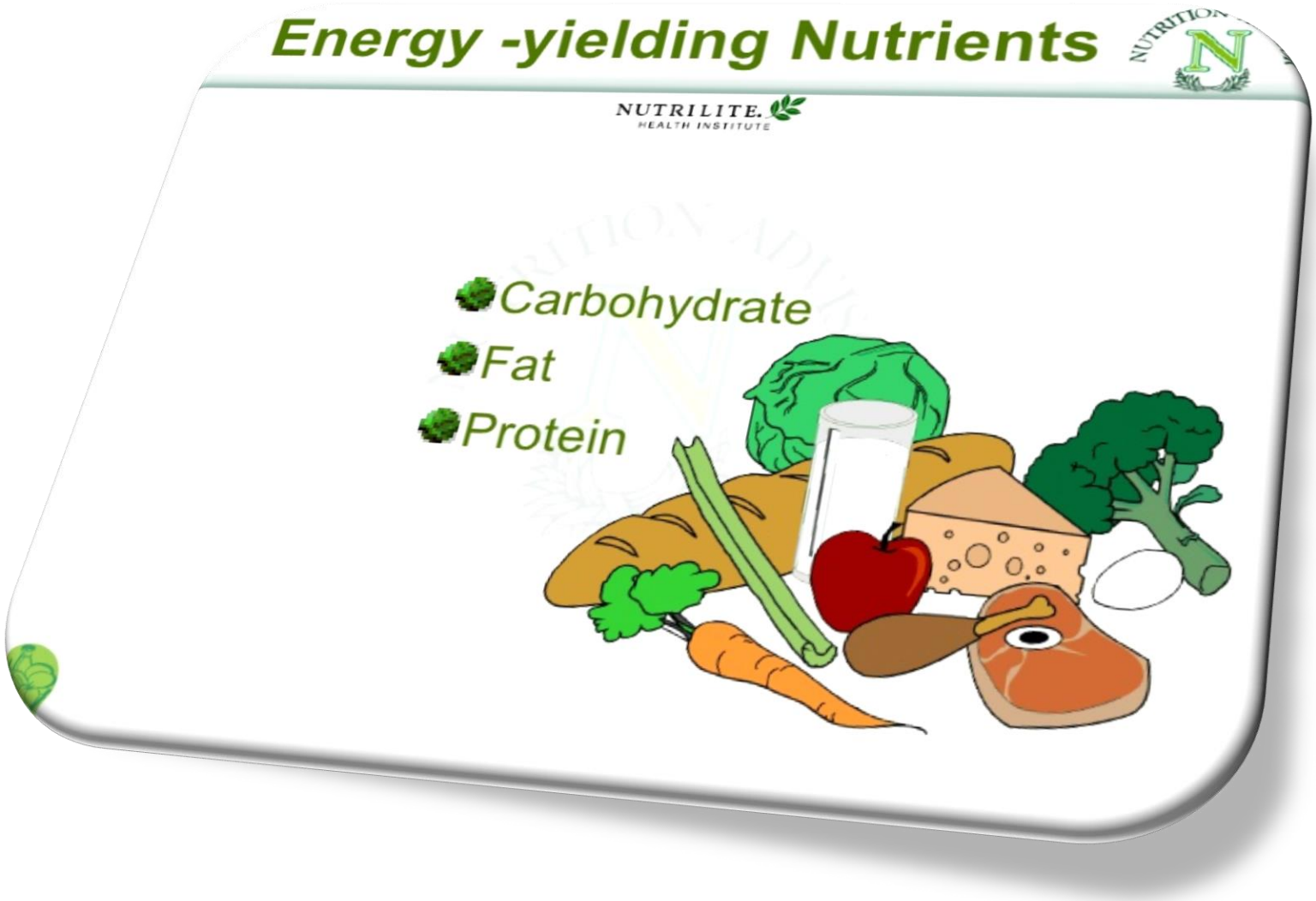


Energy-yielding nutrients:

Carbohydrates

Fats (lipids)

Proteins



MALNUTRITION

Malnutrition can be caused by

- **overnutrition** (excess energy or nutrient intake)
- or **undernutrition** (deficient energy or nutrient intake).

We usually think of malnutrition as a condition that results when the cells do not receive adequate supply of the essential nutrients because of poor diet or poor utilization of food .

Sometimes it occurs because people do not or cannot eat enough of the foods that provide the essential nutrients to satisfy body needs.

At other times people may eat well-balanced diets but suffer from diseases that prevent normal usage of the nutrients.

Overeating and the ingestion of megadoses of various vitamins and minerals (without prescription) are two major causes of overnutrition

Nutrient Deficiency

A nutrient deficiency occurs when a person lacks one or more nutrients over a period of time.

Nutrient deficiencies are classified as primary or secondary.

- Primary deficiencies are caused by inadequate dietary intake.
- Secondary deficiencies are caused by something other than diet, such as a disease condition that may cause malabsorption, accelerated excretion, or destruction of the nutrients.

Nutrient deficiencies can result in malnutrition.

Individuals at risk from poor nutritional intake

Teenagers may eat often but at unusual hours. They may miss regularly scheduled meals, become hungry, and satisfy their hunger with foods that have low nutrient density such as potato chips, cakes, soda, and candy.

Foods with low nutrient density provide an abundance of calories, but the nutrients are primarily carbohydrates and fats very limited amounts of proteins, vitamins, and minerals.

Crash diets (a way of losing body weight quickly by eating very little), which unfortunately are common among teens, sometimes result in a form of malnutrition. This condition occurs because some nutrients are eliminated from the diet when the types of foods eaten are severely restricted.

Pregnancy increases a woman's hunger and the need for certain nutrients, especially proteins, minerals, and vitamins.

The elderly, Depression, loneliness, lack of income, inability to shop, inability to prepare meals, and the state of overall health can all lead to malnutrition.

Cumulative effects of nutrition

Cumulative effects are the results of something that is done repeatedly over many years.

Effects caused by the diet over time.

For example, a long-term diet that is nutritionally inadequate in certain vitamins can cause diseases like pellagra (niacin) or scurvy (vitamin C.)

Or For example, eating excessive amounts of saturated fats for many years contributes to *atherosclerosis*, which leads to heart attacks.

Years of overeating can cause obesity and may also contribute to hypertension, type 2 (non-insulin-dependent) diabetes, gallbladder disease, foot problems, certain cancers, and even personality disorder.

Deficiency Diseases

When nutrients are seriously lacking in the diet for an extended period, deficiency diseases can occur.

e.g, iron deficiency, which is caused by a lack of the mineral iron and can cause iron deficiency anemia.

Rickets is another example of a deficiency disease. It causes poor bone formation in children and is due to insufficient calcium and vitamin D. These same deficiencies cause osteomalacia “adult rickets” in young adults and osteoporosis in older adults.

TABLE OF DEFICIENCY DUE TO VITAMIN

VITAMINS	DISEASES	SYMPTOMS
VITAMIN A	NIGHT BLINDNESS	POOR NIGHT VISION,LOSS OF NIGHT VISION
VITAMIN B	BERI-BERI	NERVOUSNESS,PARALYSIS,WEAK MUSCLES
VITAMIN C	SCURVY	BLEEDING OF GUMS ,SWELLING OF JOINTS
VITAMIN D	RICKETS	WEAK BONES,DECAYING TEETH
VITAMIN K	HAEMORRHAGE	CLOTTING OF BLOOD AFFECTED

TABLE OF DEFICIENCY DUE TO MINERALS

MINERALS	SYMPTOMS
CALCIUM	BRITTLE BONES ,EXCESSIVE BLEEDING,STUNNED GROWTH.
PHOSPHORUS	BAD BONES AND TEETH,BODY WEEKNESS
SODIUM	DEHYDRATION,EXTREME BODY WEEKNESS
POTASSIUM	MUSCLE WEEKNESS,PARALYSIS
IRON	ANAEMIA
IODINE	GOITER
FLUORINE	DENTAL DECAY

Nutrition assessment

A nutrition assessment is an in-depth evaluation of both objective and subjective data related to an individual's food and nutrient intake, lifestyle, and medical history.

Once the data on an individual is collected and organized, the practitioner can assess and evaluate the nutritional status of that person

Elements of the Assessment

The data for a nutritional assessment falls into four categories:

anthropometric , biochemical , clinical, and dietary.

1. Anthropometrics

Anthropometrics are the objective measurements of body muscle and fat . They are used to compare individuals, to compare growth in the young, and to assess weight loss or gain in the mature individual. Weight and height are the most frequently used anthropometric measurements, and skinfold measurements of several areas of the body are also taken.

2. Clinical data

Clinical data provides information about the individual's medical history, including acute and chronic illness and diagnostic procedures, therapies, or treatments that may increase nutrient needs or induce malabsorption . Current medications need to be documented, and both prescription drugs and over-the-counter drugs, must be included in the analysis. Vitamins , minerals , and herbal preparations also need to be reviewed. Physical signs of malnutrition can be documented during the nutrition interview and are an important part of the assessment process.

3. Biochemical data

Laboratory tests based on blood and urine can be important indicators of nutritional status, but they are influenced by nonnutritional factors as well. Lab results can be altered by medications, hydration status, and disease states or other metabolic processes, such as stress . As with the other areas of nutrition assessment, biochemical data need to be viewed as a part of the whole.

The following are some of the most commonly used tests for nutritional evaluation:

- Serum albumin level measures the main protein in the blood and is used to determine protein status.
- Blood urea nitrogen (BUN) may indicate renal failure, insufficient renal blood supply, or blockage of the urinary tract.
- Creatinine excretion indicates the amount of creatinine excreted in the urine over a 24-hour period and can be used in estimating body muscle mass. If the muscle mass has been depleted, as in malnutrition, the level will be low.

- Serum creatinine indicates the amount of creatinine in the blood and is used for evaluating renal function .
- Examples of other blood tests are hemoglobin (Hgb), hematocrit (Hct), red blood cells (RBCs), and white blood cells (WBCs). A low Hgb and Hct can indicate anemia.
- Not a routine test, but ordered on many clients with heart conditions, is the lipid profile, which includes total serum cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and serum triglycerides.
- Urinalysis also can detect protein and sugar in the urine, which can indicate kidney disease and diabetes.

4. The dietary-social history

involves evaluation of food habits and is very important in the nutritional assessment of any client.

It can be difficult to obtain an accurate dietary assessment.

- The most common method is the 24-hour recall. In this method, the client is usually interviewed by the dietitian and is asked to give the types of, amounts of, and preparation used for all food eaten in the 24 hours.
- Another method is the food diary. The client is asked to list all food eaten in a 3–4-day period.

Neither method is totally accurate because clients forget or are not always totally truthful. They are sometimes inclined to say they have eaten certain foods because they know they should have done so.

Nutrition Assessment Methods

- Anthropometrics
  - The objective measurements of body muscle and fat
- Biochemical/Laboratory
  - Tests based on blood and urine- can be important indicators of nutritional status
  - Influenced by other nutritional factors as well
- Clinical Data
  - Information about the individuals medical history – acute and chronic illness, etc.
- Dietary Methods
  - 24 Hour recall
  - Food frequency questionnaire

Figure 1-3 *(A) Height is one anthropometric measurement used in the nutrition assessment. (B) Weight is an anthropometric measurement used in the nutrition assessment. (C) Head circumference is an anthropometric measurement used to assess brain development during the first year of life. (D) Skinfold is an anthropometric measurement used to assess lean muscle mass versus fat.*

Dietary Reference Intakes (DRI)
and
ENERGY

Dietary Reference Intakes (DRI)

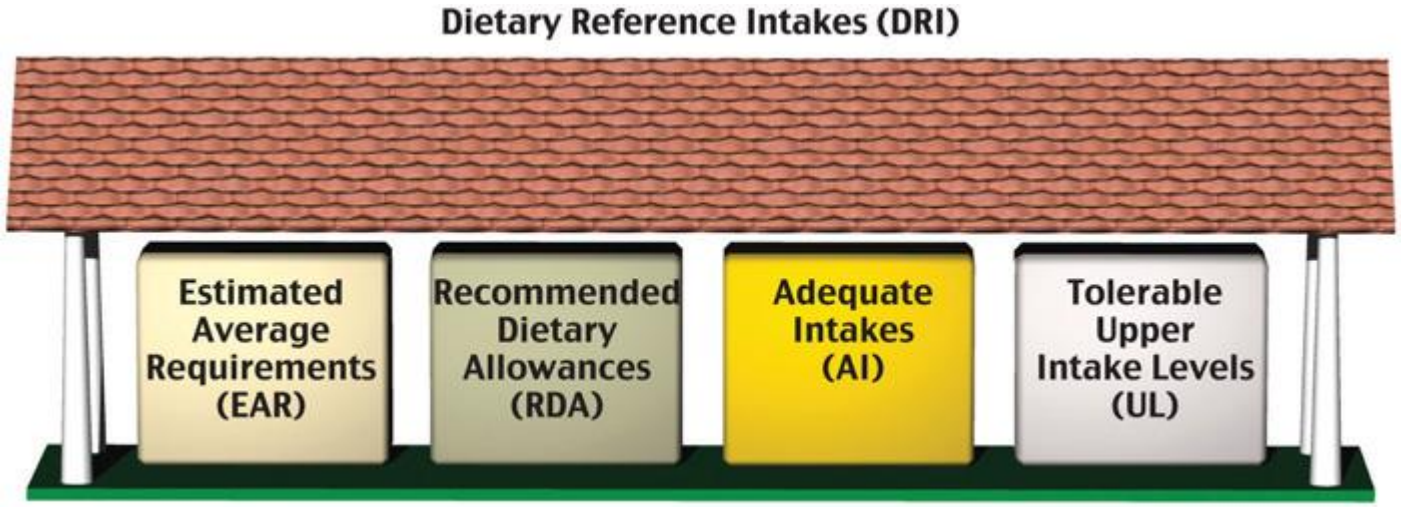
- The Dietary Reference Intakes (DRI) are a set of scientifically based nutrient reference values for healthy populations.

- Estimates of the amounts of nutrients required to prevent deficiencies and maintain optimal health and growth.

Components the of Dietary Reference Intakes

- The DRI consist of 4 dietary reference standards for the intake of nutrients designated for specific age, physiologic states, and gender:

1. Estimated Average Requirement (EAR).
2. Recommended Dietary Allowances (RDA).
3. Adequate intake (AI).
4. Tolerable Upper Limit (UL).



1. Estimated Average Requirement (EAR)

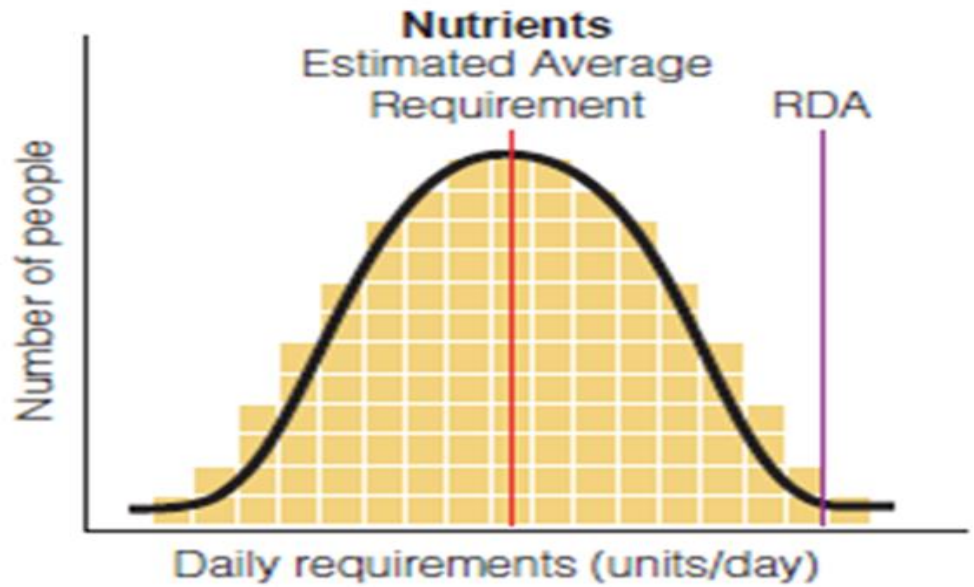
- Is the average daily nutrient intake level estimated to meet(reach) the requirement of one half of the healthy individuals in a particular life stage and gender group.
- It is useful in estimating the actual requirement in groups and individuals
- expected to satisfy the needs of 50% of the people in that age group based on a review of the scientific literature

The Estimated Average Requirement (EAR) is the intake level for a nutrient at which the needs of 50 percent of the population will be met. Because the needs of the other half of the population will not be met by this amount.

2. Recommended Dietary Allowances (RDA)

- The RDA reflect the average daily amount of a nutrient considered adequate to meet the needs of most(97-98%) healthy people in life stage and gender group.

FIGURE 1-2 | Nutrient Intake Recommendations



The nutrient intake recommendations are set high enough to cover nearly everyone's requirements (the boxes represent people).

RDA is shown below for males and females aged 40–50 years

Substance	Amount (males)	Amount (females)	Top Sources in Common Measures
Water	3.7 L/day	2.7 L/day	water, watermelon, iceberg lettuce
Carbohydrates	130 g/day	130 g/day	milk, grains, fruits, vegetables
Protein	56 g/day	46 g/day	meats, fish, legumes (lentils), nuts, milk, cheeses, eggs
Fiber	38 g/day	25 g/day	barley, rolled oats, legumes, nuts, beans, apples,
Fat	20–35% of calories		oils, butter, lard, nuts, seeds, fatty meat cuts, egg yolk, cheeses
Linoleic acid, an omega-6 fatty acid (polyunsaturated)	17 g/day	12 g/day	sunflower seeds, sunflower oil, safflower oil,
alpha-Linolenic acid, an omega-3 fatty acid (polyunsaturated)	1.6 g/day	1.1 g/day	Linseed oil (Flax seed), salmon, sardines
Cholesterol	300 milligrams(mg		chicken giblets, turkey giblets, beef liver, egg yolk
Trans fatty acids	As low as possible		
Saturated fatty acids	As low as possible while consuming a nutritionally adequate diet		coconut meat, coconut oil, lard, cheeses, butter, chocolate, egg yolk
Added sugar	No more than 25% of calories		foods that taste sweet but are not found in nature, like: sweets, cookies, cakes, jam, energy drinks, soda drinks, many processed foods

3. Adequate intake (AI)

- The AI is set instead of an RDA if sufficient scientific evidence is not available to calculate an EAR or RDA.
- The AI is based on estimates of nutrient intake by group of apparently healthy people that are assumed to be adequate.

Adequate Intake (AI): The recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate-used when an RDA cannot be determined.

4. Tolerable Upper Limit (UL)

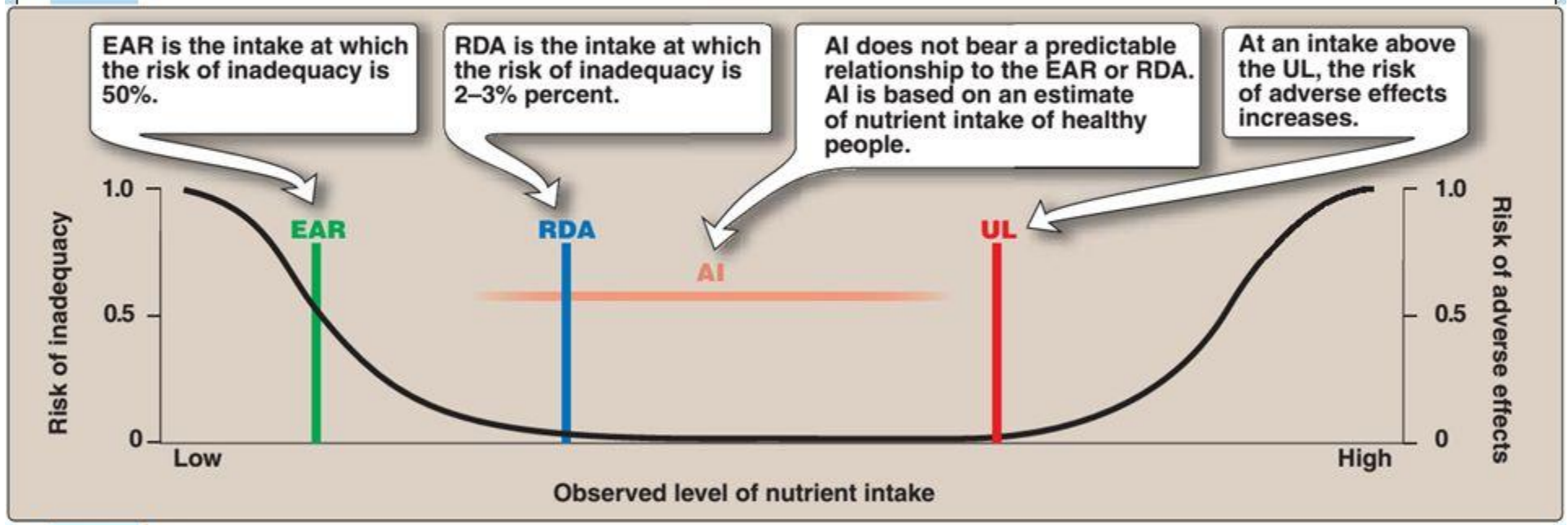
- A set of values reflecting the highest average daily nutrient intake levels that are likely to pose no risk of toxicity to almost all healthy individuals in a particular life stage and gender group.

- As intake increases above the UL, the potential risk of adverse health effects increases.

- The need for setting UL is the result of more and more people using large doses of nutrient supplements and the increasing availability of fortified foods.

Tolerable upper intake levels (UL), to caution against excessive intake of nutrients (like vitamin A) that can be harmful in large amounts. This is the highest level of daily nutrient consumption that is considered to be safe for, and cause no side effects in, 97.5% of healthy individuals in each life-stage and sex group.

B. Using the DRI



- Figure 27.4 Comparison of the components of the Dietary Reference Intakes. EAR = Estimated Average Requirement; RDA = Recommended Dietary Allowance; AI = Adequate Intake; UL = Tolerable Upper Intake Level.

Energy

Energy requirement by humans:

- estimated energy requirement (EER) is the average dietary energy intake predicted to maintain energy balance in a healthy adult of a defined age, gender, weight, and physical activity level consistent with good health.
- Energy content of food: The energy content of food is calculated from the heat released by the total combustion of food in a ***calorimeter.***
- It is expressed in kilocalories

SOURCE	CALORIES/GRAM
PROTEIN	4
CARBOHYDRATES	4
FAT	9
ALCOHOL	7

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Recommended intake ranges for energy

- **CHO** 45 to 65% of total calories
- **Fats** 20 to 35% of total calories
- **Proteins** 10 to 35% of total calories

Calories and Energy Balance

- Calories IN = Calories OUT Maintain Weight
- Calories IN > Calories OUT GAIN Weight
- Calories IN < Calories OUT LOSE Weight

How to Calculate the Energy Available from Foods:

- To calculate the energy available from a food, multiply the number of grams of carbohydrate, protein, and fat by 4, 4, and 9, respectively, Then add the results together. For example, I piece of bread with 1 Tbsp. of peanut butter on it contains 16 grams carbohydrate, 7 grams protein, and 9 grams of fat.

16 g carbohydrate x 4 kcal/g = 64 kcal

7 g protein x 4 kcal/g = 28 kcal

9 g fat x 9 kcal/g = 81 kcal

64 + 28 + 81 = 173 kcal

- By using 'Atwater factors‘ it is easy to calculate the energy in any food,
- If you know the number of grams of carbohydrate, fat, and protein in a food, you can calculate the number of calories in it.
- For example, a deluxe fast-food burger contains about 45 grams of carbohydrate, 27 grams of protein, and 39 grams of fat.

- 45 X 4=180
- 39 X 9 = 351
- 27 X 4 = 108 TOTAL = 639 Calories or 639,000 cal
- Divide each number by total to get percent of each nutrient in your diet.
  - Ex. 180/639= 28 % Carbohydrate Multiply by 100 to get the percentage

Estimated Calorie Requirements (in Kilocalories) for Each Gender and Age Group at Three Levels of Physical Activity[a]				
	Activity Level[b,c,d]			
Gender	Age (years)	Sedentary[b]	Moderately Active[c]	Active[d]
Child	2–3	1,000	1,000–1,400[e]	1,000–1,400[e]
Female	4–8	1,200	1,400–1,600	1,400–1,800
	9–13	1,600	1,600–2,000	1,800–2,200
	14–18	1,800	2,000	2,400
	19–30	2,000	2,000–2,200	2,400
	31–50	1,800	2,000	2,200
	51+	1,600	1,800	2,000–2,200
Male	4–8	1,400	1,400–1,600	1,600–2,000
	9–13	1,800	1,800–2,200	2,000–2,600
	14–18	2,200	2,400–2,800	2,800–3,200
	19–30	2,400	2,600–2,800	3,000
	31–50	2,200	2,400–2,600	2,800–3,000
	51+	2,000	2,200–2,400	2,400–2,800

Source: HHS/USDA Dietary Guidelines for Americans, 2005

How To Calculate your Recommended Dietary Allowance

1. Determine your daily caloric needs based on your sex, age and activity level. For example, if you are a 30year old, sedentary male, your daily caloric needs to be 2400 calories per day.
2. Multiply your daily caloric needs by the total recommended amount of *carbohydrates* needed each day. Since your diet should be approximately 55 percent carbohydrates, if your total caloric needs for the day is 2400 calories, your equation will look like this: 2400 X0.55 = 1320.

- This means 1320 calories you eat each day should be made up of carbohydrates.

How To Calculate your Recommended Dietary Allowance

- How much calories should make up the RDA for proteins and fat?

Look at your dietary intake and make sure you are following what is recommended for you:

- 1320 calories from carbohydrates
- 360 calories from protein (2400*0.15)
- and 720 calories from fat (2400*0.3)

An easy way to calculate your own energy requirement is to multiply your weight in by 15

Table 16-3 *Figuring Your Fat-Gram Allowance**

Step 1: Determine how many calories you need to maintain your ideal weight. Start by finding your ideal weight in Table 16-2.

Step 2: a. To find your calorie needs, multiply your ideal weight by 15 if you are moderately active or by 20 if you are very active.

b. From that total, subtract the following according to your age:

Age 25–34, subtract 0
Age 35–44, subtract 100
Age 45–54, subtract 200
Age 55–64, subtract 300
Age 65+, subtract 400

Step 3: To find your fat-gram allowance, multiply your daily calories by the percentage of fat desired (10%, 20%, or 30%); then divide by 9 calories/g.

SUGGESTED DAILY FAT INTAKE TABLE

CALORIES	30%	20%	10%
1,200	40 g	26 g	13 g
1,400	47 g	31 g	16 g
1,600	53 g	36 g	18 g
1,800	60 g	40 g	20 g
2,000	67 g	44 g	22 g
2,200	73 g	49 g	24 g
2,400	80 g	53 g	27 g

*The maximum amount of fat you can eat every day and still keep your blood cholesterol at a safe level.