THE UNIVERSITY of ADELAIDE

Revision for Final Quiz and Test

NUTRITION I

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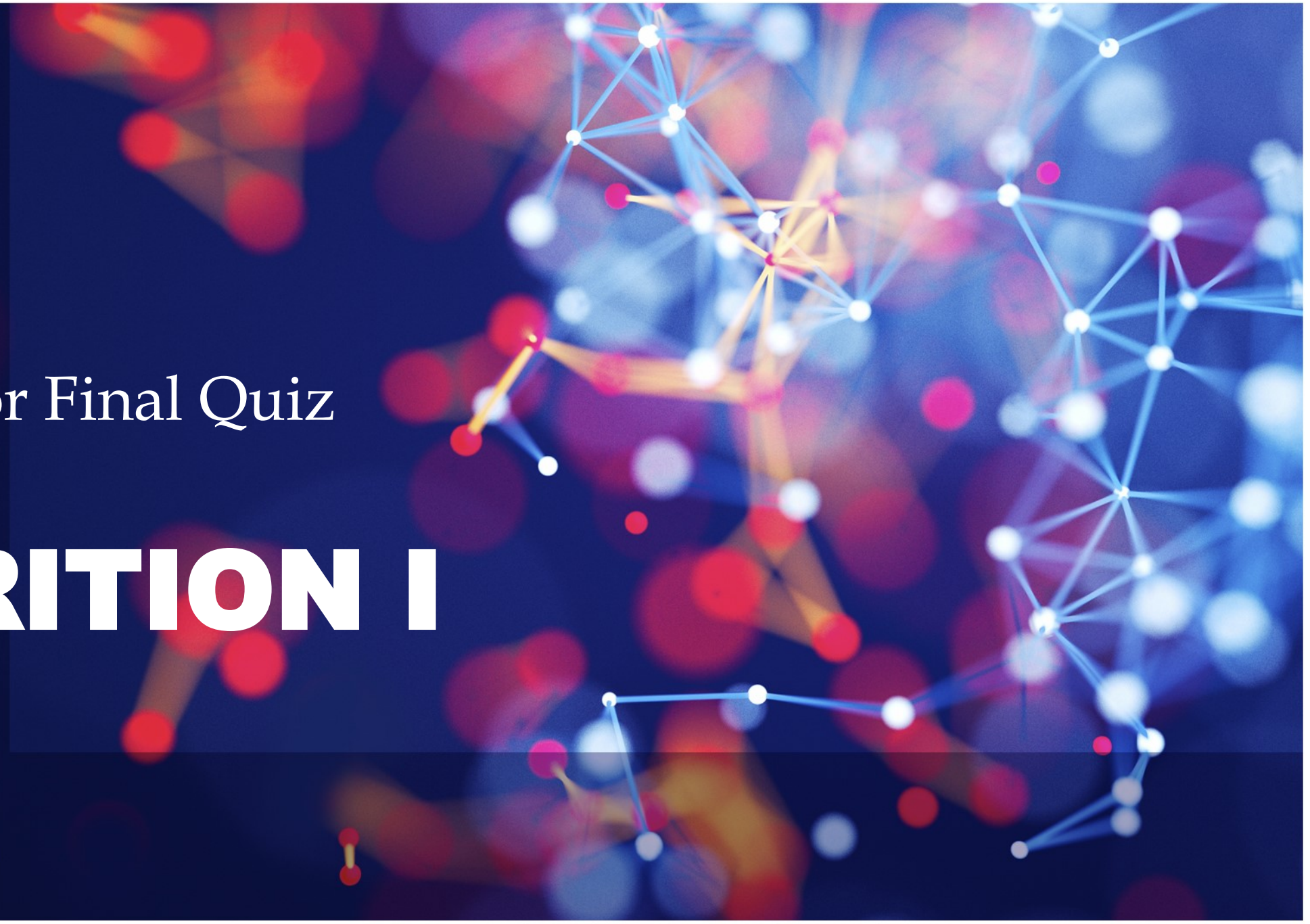


Final quiz & final exam

Instructions:

- Answer ALL questions.
- These are Closed-Book tests.

Format:

- Final quiz: 25 questions & 60 minutes, similar format to the other quizzes.
- Final exam: 3 questions & 30 minutes, short answer questions including nutrient calculations.

Materials:

- Calculator without alphanumeric memory or remote communication capabilities is permitted.
- English dictionary is allowed.

Revision

All materials covered in the course are examinable (except report writing) with a focus on the following

- 6 classes of nutrients
- Nutrient Reference values (NRVs): definitions & applications
- Healthy Eating Guidelines: Dietary Guidelines & Five Food Groups
- Macronutrients & energy metabolism
- Micronutrients: vitamins & minerals
- Non-nutrient compounds: Antioxidants & phytochemicals
- Nutrient Calculations
- Evidence-based nutrition

What's in food

- Non-nutrients
  - Fibre, phytochemicals, antioxidants, alcohol, other
- Six classes of nutrients

Nutrient:	Macronutrient	Micronutrient	Organic	Inorganic	Energy-yielding
Protein	✓		✓		✓
Lipids (fats)	✓		✓		✓
Carbohydrates	✓		✓		✓
Vitamins		✓	✓		
Minerals		✓		✓	
Water	✓			✓	

*Alcohol also yields energy, but it is not a nutrient

Nutrient Reference values (NRVs):

Acronym	Full term	Definition
EER	Estimated Energy Requirement	Estimated total energy intake for healthy, normal weight individuals in a particular group to maintain energy balance.
EAR	Estimated Average Requirement	Daily nutrient level estimated to meet the requirements of half the healthy individuals in a particular life stage and gender group. EAR is used to calculate RDI.
RDI	Recommended Dietary Intake	Average daily intake level sufficient to meet the nutritional requirements of nearly all healthy individuals (97.98%) in a life stage/gender group.
AI	Adequate Intake	Set when there is insufficient scientific evidence to calculate an EAR. AI is a nutrient level sufficient to maintain a satisfactory nutritional status of a particular life stage and gender group. It is based on observation or experimental studies on a group or groups of healthy people.
UL	Upper Intake Level	Highest average daily nutrient intake level likely to pose no adverse health effects to almost all individuals. As intake increases above the UL, the potential risk of adverse effects increases.

- NRVs apply to healthy people
- EAR, RDI, AI, UL: address nutrient adequacy
- AMDR & SDT: reduce the risk of chronic disease

Acronym	Full Term	Definition
AMDRs	Acceptable Macronutrient Distribution Ranges	An estimate of the range of intake for each macronutrient for individuals which would allow for an adequate intake of all the other micronutrients, whilst optimising general health outcomes. Expressed as a percentage contribution to energy intake.
SDTs	Suggested Dietary Targets	A daily average intake from food and beverages for certain nutrients that may help in prevention of chronic disease.

Healthy eating guidelines

- Food Groups: foods are grouped based on their nutritional characteristics
  - The Five Food Groups
  - Unsaturated oils/spread
  - Discretionary foods: not essential, high in SFA, or added sugar, salt or alcohol

- The Australian Dietary Guidelines: five principal guidelines
  - Guidelines 2: Enjoy a wide variety of nutritious foods from these five food groups every day & drink plenty of water
  - Guidelines 3: Limit intake of foods containing saturated fat, added salt, added sugars and alcohol.

Table 1 Nutritional characteristics of the Five Food Groups

Food Group name	Grain (cereal) foods, mostly wholegrain and/or high cereal fibre varieties	Vegetables and legumes/beans	Fruit	Milk, yoghurt, cheese and/or alternatives, mostly reduced fat	Lean meat and poultry, fish, eggs, tofu, nuts and seeds, legumes/beans
Main distinguishing nutrients	carbohydrate protein iron dietary fibre thiamin folate iodine	beta-carotene and other carotenoids vitamin C folate dietary fibre	vitamin C dietary fibre	calcium protein riboflavin vitamin B_{12}	protein iron zinc vitamin B_{12} (animal foods only) long chain omega 3 fatty acids
Other significant nutrients*	energy magnesium zinc riboflavin niacin vitamin E	Carbohydrate (potato, sweet potato, sweet corn, legumes) magnesium iron potassium	carbohydrate folate beta-carotene potassium	energy fat carbohydrate magnesium zinc potassium	dietary fibre (plant foods only) energy essential fatty acids niacin vitamin E (seeds, nuts)

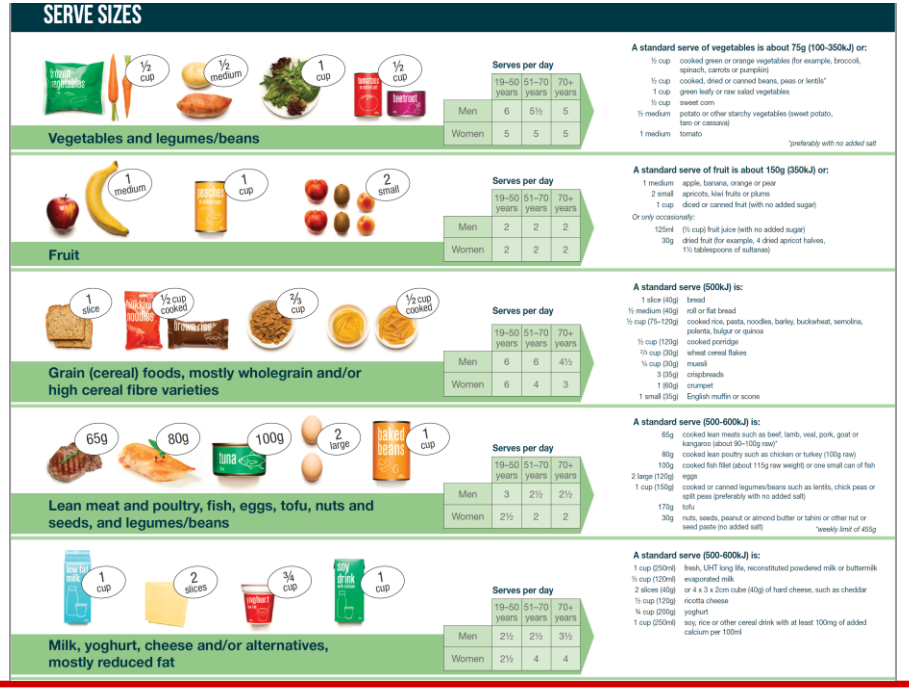
* *Some foods from the Five Food Groups (such as some bread, breakfast cereal and most cheese) can also contribute significant amounts of sodium*

NRV, Dietary Guidelines & five food groups - Application of the knowledge to practice

- NRVs
  - Apply correct NRVs for individuals vs. populations

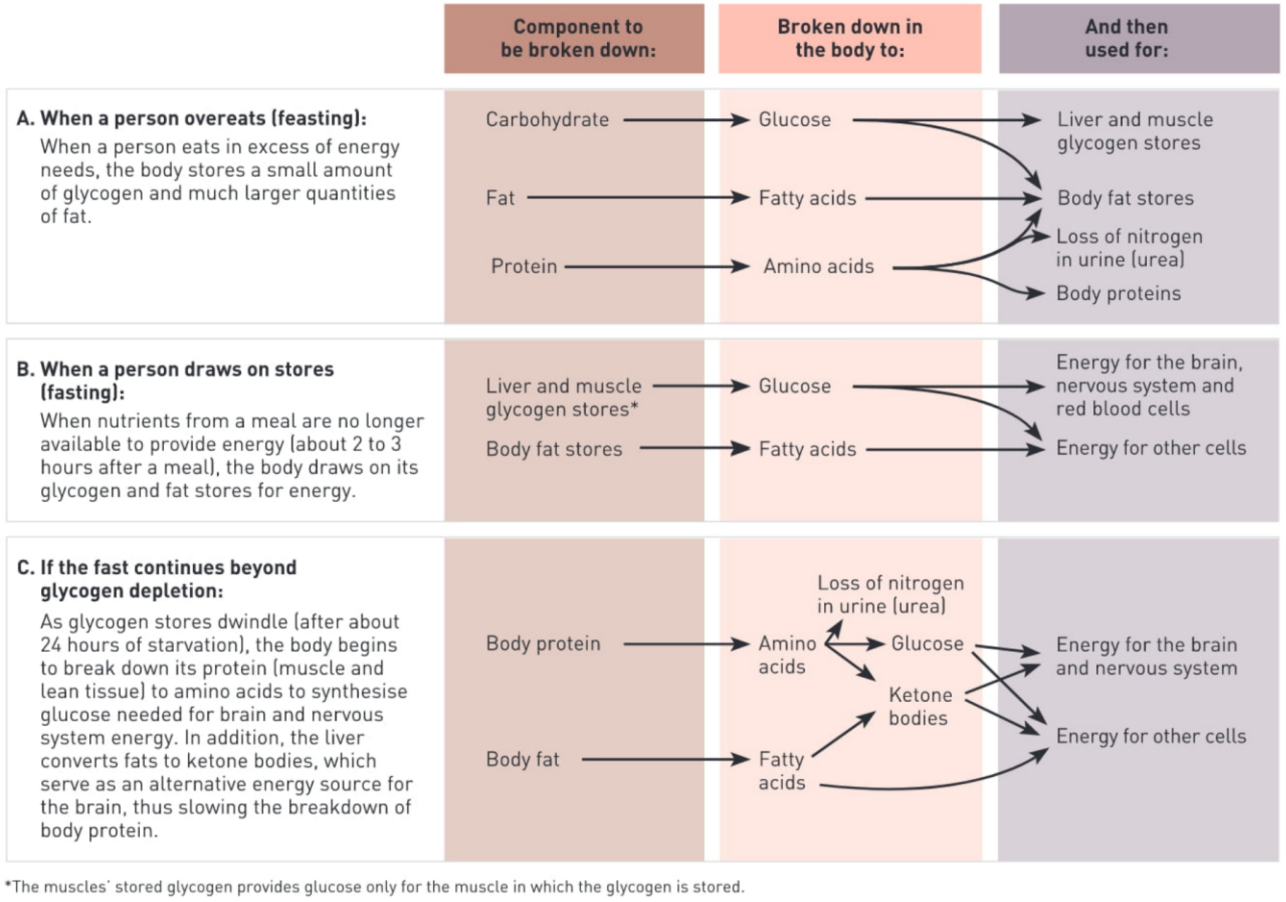
Age	EAR	RDI
Boys		
9-13 yr	6 mg/day	8 mg/day
14-18 yr	8 mg/day	11 mg/day
Girls		
9-13 yr	6 mg/day	8 mg/day
14-18 yr	8 mg/day	15 mg/day
Women		
19-30 yr	8 mg/day	18 mg/day
31-50 yr	8 mg/day	18 mg/day

- Foundation diet based on Five Food Groups
  - Energy & nutrient needs for the smallest & least active in each age & gender group



Macronutrients & energy metabolism

FIGURE 7.22 Feasting and fasting



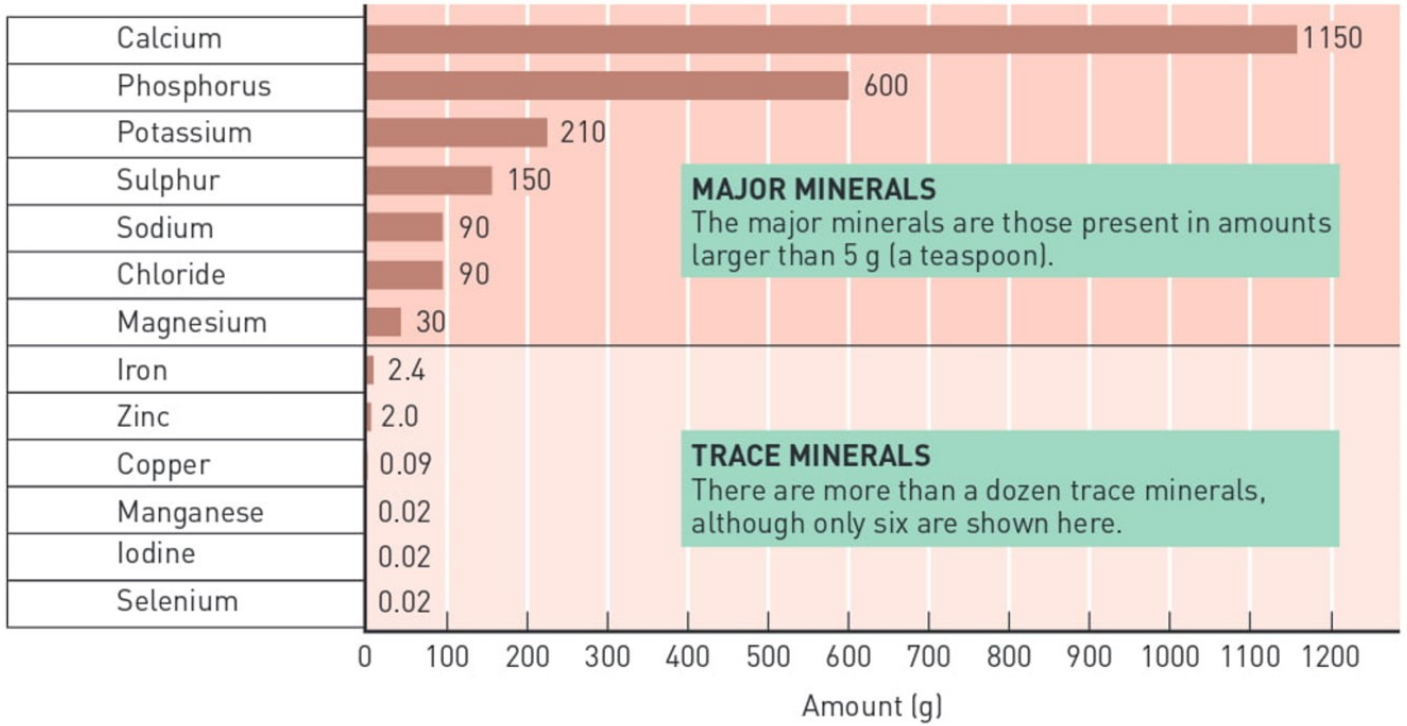
*The muscles' stored glycogen provides glucose only for the muscle in which the glycogen is stored.

- Describe metabolism of each macronutrient under feasting & fasting conditions
- Macronutrients in excess of energy requirements are stored mostly as fat
- Fat can provide energy for most cells but red blood cells rely on glucose
- In prolonged fasting, body protein is broken down to provide glucose

Major vs. trace minerals

FIGURE 12.10 Minerals in a 60-kilogram human body

Not only are the major minerals present in the body in larger amounts than the trace minerals, they are also needed by the body in larger amounts. Recommended intakes for the major minerals are stated in *hundreds of milligrams* or *grams*, whereas those for the trace minerals are listed in *tens of milligrams* or even *micrograms*.



Major minerals

MINERAL AND CHIEF FUNCTIONS	DEFICIENCY SYMPTOMS	TOXICITY SYMPTOMS	SIGNIFICANT SOURCES
Sodium			
Maintains normal fluid and electrolyte balance; assists in nerve impulse transmission and muscle contraction	Muscle cramps, mental apathy, loss of appetite	Oedema, acute hypertension	Table salt, soy sauce; moderate amounts in meats, milks, breads and vegetables; large amounts in processed foods
Chloride			
Maintains normal fluid and electrolyte balance; part of hydrochloric acid found in the stomach, necessary for proper digestion	Do not occur under normal circumstances	Vomiting	Table salt, soy sauce; moderate amounts in meats, milks, eggs; large amounts in processed foods
Potassium			
Maintains normal fluid and electrolyte balance; facilitates many reactions; supports cell integrity; assists in nerve impulse transmission and muscle contractions	Irregular heartbeat, muscular weakness, glucose intolerance	Muscular weakness; vomiting; if given into a vein, can stop the heart	All whole foods; meats, milks, fruits, vegetables, grains, legumes

Major minerals

MINERAL AND CHIEF FUNCTIONS	DEFICIENCY SYMPTOMS	TOXICITY SYMPTOMS	SIGNIFICANT SOURCES
Calcium			
Mineralisation of bones and teeth; also involved in muscle contraction and relaxation, nerve functioning, blood clotting and blood pressure	Stunted growth in children; bone loss (osteoporosis) in adults	Constipation; increased risk of urinary stone formation and kidney dysfunction; interference with absorption of other minerals	Dairy products, canned fish with bones, calcium-fortified soy milk, tofu, greens (bok choy, broccoli, chard), legumes
Phosphorus			
Mineralisation of bones and teeth; part of every cell; important in genetic material, part of phospholipids, used in energy transfer and in buffer systems that maintain acid–base balance	Muscular weakness, bone pain[a]	Calcification of non-skeletal tissues, particularly the kidneys	All animal tissues (meat, fish, poultry, eggs, milk)
Magnesium			
Bone mineralisation, building of protein, enzyme action, normal muscle contraction, nerve impulse transmission, maintenance of teeth and functioning of immune system	Weakness; confusion; if extreme, convulsions, bizarre muscle movements (especially of eye and face muscles), hallucinations, and difficulty in swallowing; in children, growth failure[b]	From non-food sources only; diarrhoea, alkalosis, dehydration	Nuts, legumes, whole grains, dark green vegetables, seafood, chocolate, cocoa
Sulphate			
As part of proteins, stabilises their shape by forming disulphide bridges; part of the vitamins biotin and thiamin and the hormone insulin	None known; protein deficiency would occur first	Toxicity would occur only if sulphur-containing amino acids were eaten in excess; this (in animals) suppresses growth	All protein-containing foods (meats, fish, poultry, eggs, milk, legumes, nuts)

[a] Dietary deficiency rarely occurs, but some drugs can bind with phosphorus, making it unavailable and resulting in bone loss that is characterised by weakness and pain.

[b] A still more severe deficiency causes tetany, an extreme, prolonged contraction of the muscles similar to that caused by low blood calcium.

Trace minerals

MINERAL AND CHIEF FUNCTIONS	DEFICIENCY SYMPTOMS	TOXICITY SYMPTOMS[a]	SIGNIFICANT SOURCES
IRON			
Part of the protein haemoglobin, which carries oxygen in the blood; part of the protein myoglobin in muscles, which makes oxygen available for muscle contraction; necessary for energy metabolism	Anaemia: weakness, fatigue, headaches; impaired work performance; impaired immunity; pale skin, nail beds, mucous membranes and palm creases; concave nails; inability to regulate body temperature; pica	GI distress; iron overload: infections, fatigue, joint pain, skin pigmentation, organ damage	Red meats, fish, poultry, shellfish, eggs, legumes, dried fruits
ZINC			
Part of insulin and many enzymes; involved in making genetic material and proteins, immune reactions, transport of vitamin A, taste perception, wound healing, sperm production and normal foetal development	Stunted growth, delayed sexual maturation, impaired immune function, hair loss, eye and skin lesions, loss of appetite	Loss of appetite, impaired immunity, low HDL, copper and iron deficiencies	Protein-containing foods: red meats, fish, shellfish, poultry, whole grains; fortified cereals
IODINE			
A component of the thyroid hormones that help to regulate growth, development and metabolic rate	Underactive thyroid gland, goitre, mental and physical retardation (cretinism)	Underactive thyroid gland, elevated TSH, goitre	Iodised salt; seafood and seaweed; plants grown in iodine-rich soil and animals fed those plants

[a] Acute toxicities of many minerals cause abdominal pain, nausea, vomiting and diarrhoea.

Trace minerals

MINERAL AND CHIEF FUNCTIONS	DEFICIENCY SYMPTOMS	TOXICITY SYMPTOMS[a]	SIGNIFICANT SOURCES
SELENIUM			
Part of an enzyme that defends against oxidation; regulates thyroid hormone	Associated with Keshan disease	Nail and hair brittleness and loss; fatigue, irritability and nervous system disorders; skin rash, garlic breath odour	Seafood, meat, whole grains, fruits and vegetables (depending on soil content)
COPPER			
Helps form haemoglobin; part of several enzymes	Anaemia, bone abnormalities	Liver damage	Seafood, nuts, legumes, whole grains, seeds
MANGANESE			
Cofactor for several enzymes; bone formation	Rare	Nervous symptom disorders	Nuts, whole grains, leafy vegetables, tea
FLUORIDE			
Maintains health of bones and teeth; confers decay resistance on teeth	Susceptibility to tooth decay	Fluorosis (pitting and discoloration) of teeth	Drinking water (if fluoridated), tea, seafood
CHROMIUM			
Enhances insulin action, may improve glucose intolerance	Impaired glucose tolerance	None reported	Meats (liver), whole grains, brewer's yeast
MOLYBDENUM			
Cofactor for several enzymes	Unknown	None reported	Legumes, cereals, nuts

[a] Acute toxicities of many minerals cause abdominal pain, nausea, vomiting and diarrhoea.

Major minerals

Can be grouped into two groups:

- Fluid & Electrolyte Balance
  - Sodium
  - Chloride
  - Potassium
- Bone Growth
  - Calcium
  - Phosphorous
  - Magnesium

- Nerve impulse transmission and muscle contraction
  - Sodium, Chloride, Potassium, Calcium, Magnesium

Trace minerals

- Factors that affect iron & zinc absorptions
- Practical ways to improve non-haem iron absorption
- We focused on:
  - **Iron (Fe)**
  - **Zinc (Zn)**
  - **Iodine (I)**
  - **Selenium (Se)**
  - **Fluoride (F)**

Summary of minerals with common functions

Role	Minerals involve
Fluid & electrolyte balance	Na, Cl, K
Structure of the bones & teeth	Ca, P, Mg, Mn, F
Nerve impulse transmission & muscle contraction, regulate blood pressure	Na, Cl, K, Ca, Mg
Blood clotting	Ca, Mg, Zn
Red blood cells production	Fe, Cu
Insulin activity	Zn, Cr
Thyroid hormone	I, Se

Water-soluble vs. fat-soluble vitamins

	WATER-SOLUBLE VITAMINS: B GROUP VITAMINS AND VITAMIN C	FAT-SOLUBLE VITAMINS: VITAMINS A, D, E AND K
Absorption	Directly into the blood	First into the lymph, then the blood
Transport	Travel freely	Many require protein carriers
Storage	Circulate freely in water-filled parts of the body	Stored in the cells associated with fat
Excretion	Kidneys detect and remove excess in urine	Less readily excreted; tend to remain in fat-storage sites
Toxicity	Possible to reach toxic levels when consumed from supplements	Likely to reach toxic levels when consumed from supplements
Requirements	Needed in frequent doses (perhaps one to three days)	Needed in periodic doses (perhaps weeks or even months)

Summary of water soluble vitamins

The water-soluble vitamins

VITAMIN AND CHIEF FUNCTIONS	DEFICIENCY SYMPTOMS	TOXICITY SYMPTOMS	FOOD SOURCES
THIAMIN			
Part of coenzyme TPP in energy metabolism	Beriberi (oedema or muscle wasting), anorexia and weight loss, neurological disturbances, muscular weakness, heart enlargement and failure	None reported	Enriched, fortified or wholegrain products; pork
RIBOFLAVIN			
Part of coenzymes FAD and FMN in energy metabolism	Inflammation of the mouth, skin and eyelids	None reported	Milk products; enriched, fortified or wholegrain products; liver
NIACIN			
Part of coenzymes NAD and NADP in energy metabolism	Pellagra (diarrhoea, dermatitis and dementia)	Niacin flush, liver damage, impaired glucose tolerance	Protein-rich foods
BIOTIN			
Part of coenzyme in energy metabolism	Skin rash, hair loss, neurological disturbances	None reported	Widespread in foods; GI bacteria synthesis
PANTOTHENIC ACID			
Part of coenzyme A in energy metabolism	Digestive and neurological disturbances	None reported	Widespread in foods

VITAMIN AND CHIEF FUNCTIONS	DEFICIENCY SYMPTOMS	TOXICITY SYMPTOMS	FOOD SOURCES
VITAMIN B_6			
Part of coenzymes used in amino acid and fatty acid metabolism	Scaly dermatitis, depression, confusion, convulsions, anaemia	Nerve degeneration, skin lesions	Protein-rich foods
FOLATE			
Activates vitamin B_{12}; helps synthesise DNA for new cell growth	Anaemia, glossitis, neurological disturbances (e.g. neural tube defects in infants), elevated homocysteine	Masks vitamin B_{12} deficiency	Legumes, vegetables, fortified grain products
VITAMIN B_{12}			
Activates folate; helps synthesise DNA for new cell growth; protects nerve cells	Anaemia; nerve damage and paralysis	None reported	Foods derived from animals
VITAMIN C			
Synthesis of collagen, carnitine, hormones, neurotransmitters; antioxidant	Scurvy (bleeding gums, pinpoint haemorrhages, abnormal bone growth and joint pain)	Diarrhoea, GI distress	Fruits and vegetables

- B-group: energy production
  - Folate & B12: depends on each for activation & involve in new cell production
  - Vit C: acts as antioxidant in addition to other functions

Summary – the fat-soluble vitamins

VITAMIN AND CHIEF FUNCTIONS	DEFICIENCY SYMPTOMS	TOXICITY SYMPTOMS	SIGNIFICANT SOURCES
Vitamin A Vision; maintenance of cornea, epithelial cells, mucous membranes, skin; bone and tooth growth; reproduction; immunity	Infectious diseases, night blindness, blindness (xerophthalmia), keratinisation	Reduced bone mineral density, liver abnormalities, birth defects	Retinol: milk and milk products Beta-carotene: dark green leafy and deep yellow/orange vegetables
Vitamin D Mineralisation of bones (raises blood calcium and phosphorus by increasing absorption from digestive tract, withdrawing calcium from bones and stimulating retention by kidneys)	Rickets, osteomalacia	Calcium imbalance (calcification of soft tissues and formation of stones)	Synthesised in the body with the help of sunshine; fortified margarine
Vitamin E Antioxidant (stabilisation of cell membranes, regulation of oxidation reactions, protection of polyunsaturated fatty acids [PUFA] and vitamin A)	Erythrocyte haemolysis, nerve damage	Haemorrhagic effects	Vegetable oils, nuts and seeds
Vitamin K Synthesis of blood-clotting proteins and bone proteins	Haemorrhage	None known	Synthesised in the body by GI bacteria; green leafy vegetables

Estimate Energy Requirements (EER)

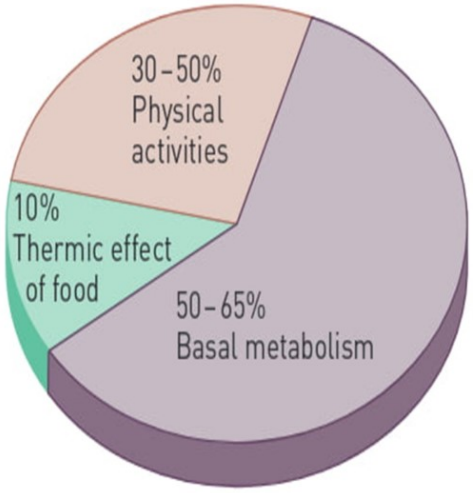
To estimate energy requirements (EER), use the following equation:

EER = BMR x PAL

Where:

BMR = Basal Metabolic Rate

PAL = Physical Activity Level



Calculating EER is generally broken down into the following 3 steps:

Step 1: Calculate BMR

Step 2: Decide on a PAL

Step 3: EER = BMR x PAL

Calculate Basal Metabolic Rate (BMR)

- Harris-Benedict Equation (kJ/d):
  - M = 278 + (57.5 x W) + (20.9 x H) – (28.3 x A)
  - F = 2741 + (40.0 x W) + (7.7 x H) – (19.6 x A)

M= male
F=female
W= weight in Kg
H= height in cm
A= age in years

- Schofield Equation (MJ/d)

18-30 years	30 – 60 years
M=0.063 x wt + 2.896	M= 0.048 x wt + 3.653
F=0.062 x wt + 2.036	F= 0.034 x wt + 3.538

1 MJ = 1000 kJ

Physical activity level (PAL)

	PHYSICAL ACTIVITY LEVELS	DESCRIPTION
Bed rest	1.2	At rest, exclusively sedentary or lying (chair-bound or bed-bound)
Very sedentary	1.4–1.5	Exclusively sedentary activity/seated work with little or no strenuous leisure activity[a]
Light active	1.6–1.7	Sedentary activity/seated work with some requirement for occasional walking and standing but little or no strenuous leisure activity[a]
Moderate active	1.8–1.9	Predominantly standing or walking work[a]
Heavy to vigorous active	2.0–2.4	Heavy occupational work or highly active leisure[a]

[a] For sports and strenuous leisure activities (30–60 minutes, 4–5 times per week) add 0.3 PAL units per day.

Body Mass Index (BMI)

Calculating Body Mass Index (BMI)

BMI = Weight(kg) divided by height (m^2)

BMI Classification (NHMRC): kg/m^2

Underweight:	BMI	< 18.5
Normal range:	BMI	18.5 – 24.9
Overweight:	BMI	25 - 24.9
Obese:	BMI	30 - 39.9

Other nutrient calculations

- Estimate energy requirement (EER)
- For a given EER, calculate amount of CHO/protein/Fat
  - Using AMDR to choose the % energy from CHO/protein/Fat: total % E needs to add up to 100%
  - Amount of each macronutrient required, e.g. CHO: %E for CHO/Atwater factor for CHO (16 kJ/g)
- Energy density of a food:
  - Energy of the food (kJ)/ weight (g)

What you need to remember

- Yes – need to remember
  - BMI
  - Atwater factors
  - AMDR
  - EER = BMR x PAL

- No need – will be provided
  - BMR equations

Harris-Benedict Equation (kJ/d):

- M = 278 + (57.5 x W) + (20.9 x H) – (28.3 x A)
- F = 2741 + (40.0 x W) + (7.7 x H) – (19.6 x A)

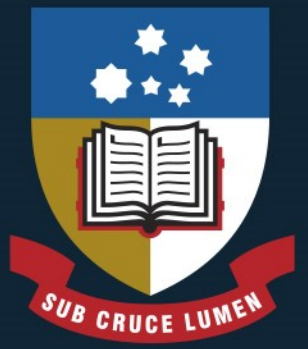
Schofield Equation (MJ/d)

<u>18-30 years</u>

- M=0.063 x wt + 2.896
- F=0.062 x wt + 2.036

Summary

- Go over all materials covered in the course except report writing
- Have a good understanding of the topics
- Use the allocated marks as a guide for the detail required
- Have a simple calculator for nutrient calculations



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