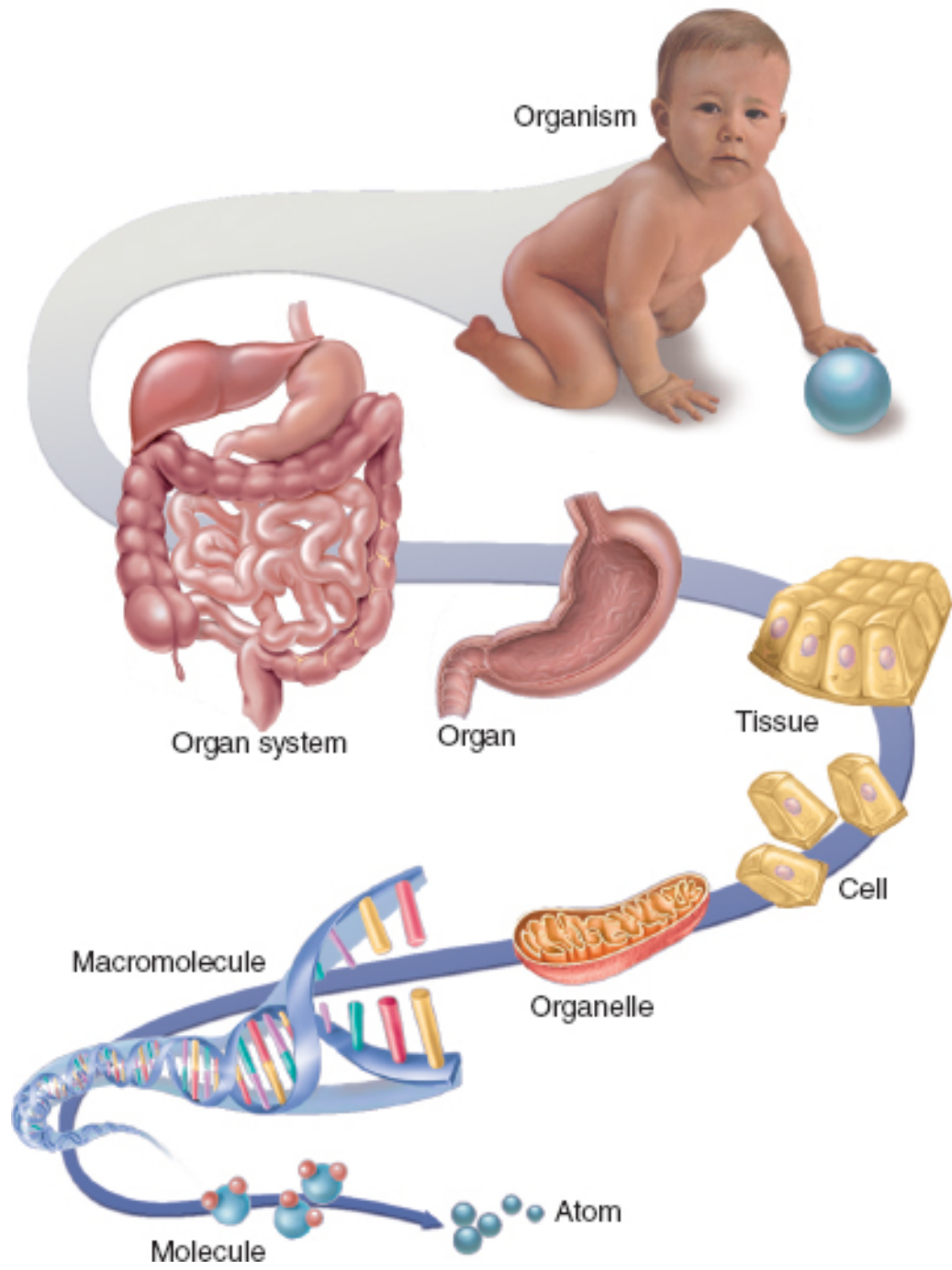


# Minerals for health



# Outline

- Whole body composition
- Minerals
  - Calcium
  - Potassium
  - Sodium
  - Magnesium
- Trace minerals
  - Iodine
  - Iron
  - Zinc



Organism

Organ system

Organ

Tissue

Cell

Organelle

Macromolecule

Molecule

Atom

# Human Body Ingredients

The four ingredients below are essential parts of the body's protein, carbohydrate and fat architecture.



O

OXYGEN

65.0%

Critical to the conversion of food into energy.

C

CARBON

18.5%

The so-called backbone of the building blocks of the body and a key part of other important compounds, such as testosterone and estrogen.

H

HYDROGEN

9.5%

Helps transport nutrients, remove wastes and regulate body temperature. Also plays an important role in energy production.

N

NITROGEN

3.3%

Found in amino acids, the building blocks of proteins; an essential part of the nucleic acids that constitute DNA.

## Other Key Elements

Calcium 1.5%

Lends rigidity and strength to bones and teeth; also important for the functioning of nerves and muscles, and for blood clotting.

Phosphorus 1.0%

Needed for building and maintaining bones and teeth; also found in the molecule ATP (adenosine triphosphate), which provides energy that drives chemical reactions in cells.

Potassium 0.4%

Important for electrical signaling in nerves and maintaining the balance of water in the body.

Sulfur 0.3%

Found in cartilage, insulin (the hormone that enables the body to use sugar), breast milk, proteins that play a role in the immune system, and keratin, a substance in skin, hair and nails.

Chlorine 0.2%

Needed by nerves to function properly; also helps produce gastric juices.

Sodium 0.2%

Plays a critical role in nerves' electrical signaling; also helps regulate the amount of water in the body.

Magnesium 0.1%

Plays an important role in the structure of the skeleton and muscles; also found in molecules that help enzymes use ATP to supply energy for chemical reactions in cells.

Iodine (trace amount)

Part of an essential hormone produced by the thyroid gland; regulates metabolism.

Iron (trace amount)

Part of hemoglobin, which carries oxygen in red blood cells.

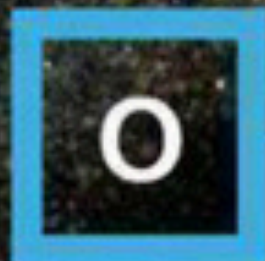
Zinc (trace amount)

Forms part of some enzymes involved in digestion.

(Percentage of body weight. Source: *Biology*, Campbell and Reece, eighth edition.)

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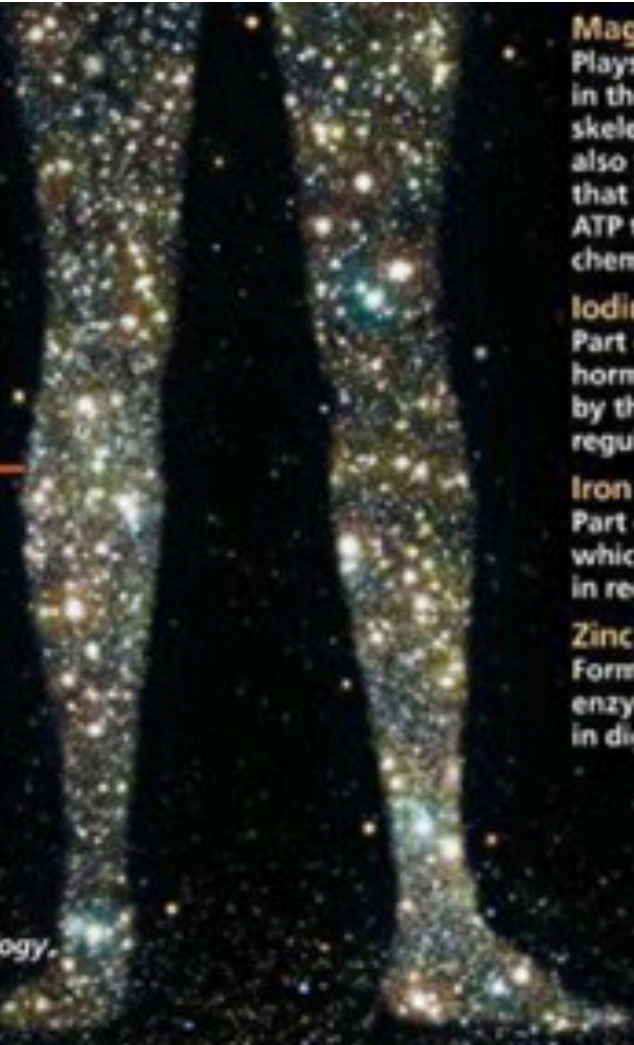
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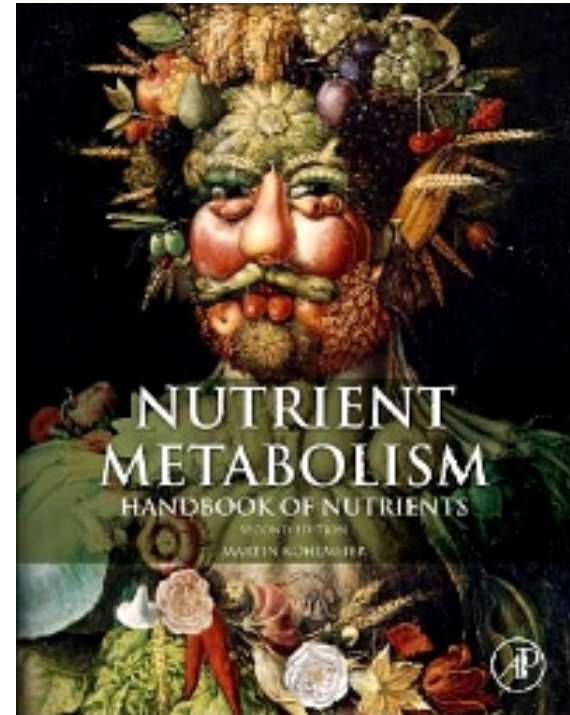


# Levels of sufficiency

- Toxicity
- Optimal level
- Suboptimal – still in normal range
- Decreased stores
- Deficient
- Frank deficiency

# Example mineral

- Main function
- Other functions
- Absorption
- Losses
- Food sources
- Supplement notes/excess





# Calcium

- Main function
  - Alkaline earth metal. Divalent ( $\text{Ca}^{2+}$ )
  - Major mineral in bone
- Other functions
  - Intracellular and hormone-like signalling
  - Neurotransmission
  - Muscle contraction
  - Many more

# Calcium

- Absorption

- Absorbed with 15-70% efficacy in the small intestine.
- Efficacy dependant on vitamin D status, age, amount ingested and concentration of other compounds in the meal.
- Vitamin D is a potent stimulus for calcium absorption.
- Phosphate (milk, meat, colas and many processed food) inhibits absorption.
- Oxalate and phytates also inhibit absorption.

- Losses

- High salt intake increases urinary calcium loss.
- Profuse sweating also increases losses significantly.

# Calcium

- Food sources



- Supplement notes

- Excessive intake can cause renal stone formation in some people.
- If supplementing, around 500mg of calcium is needed a day – more may be detrimental.

# Potassium

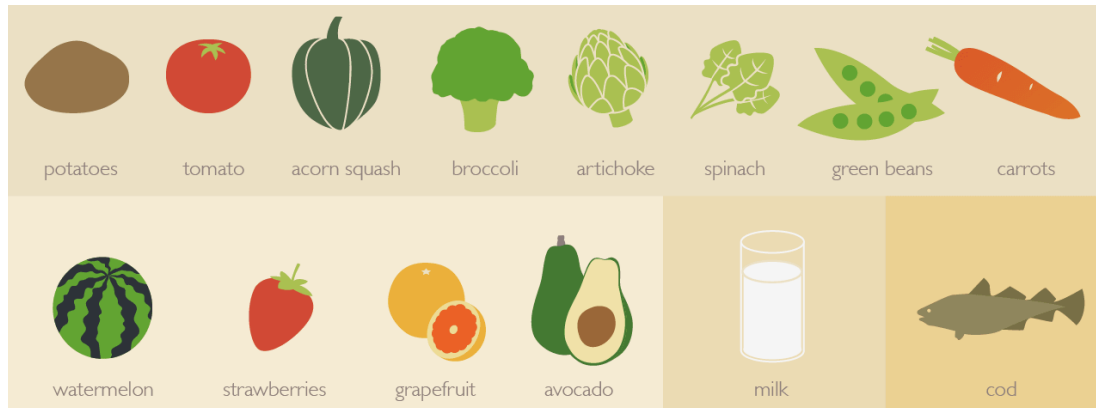
- Main function
  - Main cationic osmolyte within cells ( $K^+$ )
  - Important for neuronal signalling, heart impulse transmission.
- Other functions
  - Nutrient and metabolite transport (across cell membranes)
  - Enzyme activation
  - DASH diet – helps to reduce blood pressure when balanced with decreased sodium.

# Potassium

- Absorption
  - Nearly all potassium is absorbed in the small intestine.
- Losses
  - Some medications (laxatives and some diuretics) increase losses.

# Potassium

- Food sources



- Supplement notes

- Excessive intake leads to muscle weakness, possible irregular heart beat and death due to cardiac arrest.

# Sodium

- Main function
  - Main cationic osmolyte in the blood and extracellular fluid ( $\text{Na}^+$ ).
- Other functions
  - Transport of nutrients and metabolite in intestines, kidneys and many other tissues.
- Absorption
  - Near complete absorption due to several absorption mechanisms.
- Losses
  - Mostly lost through urine and sweat. One hour of strenuous activity  $\approx$  500ml sweat  $\approx$  0.6grams of sodium.

# Sodium

- Food sources



- Average South African gets around 11grams of salt per day!
- About half from salty foods, the remainder from salt added to food.
- Excess
  - Higher than minimal intake can increase blood pressure especially in genetically susceptible people.



# Magnesium

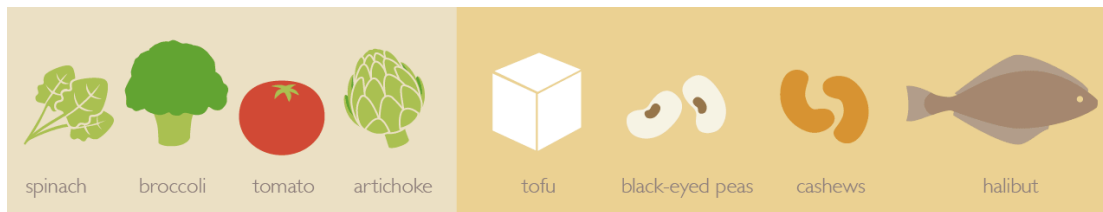
- Main function
  - Essential cofactor in many reactions, around 300 enzymes.
- Other functions
  - Muscle and nerve depolarization, stabilization of DNA, component of bone.

# Magnesium

- Absorption
  - 30-60% absorption
  - Phosphate and phytate inhibit absorption but not calcium.
- Losses
  - Increased usage during stress, physical activity and alcohol intake.
- Deficiency symptoms
  - Depression, muscle contractions and cramps, tingling, numbness, hypertension, abnormal heart rhythms.

# Magnesium

- Food sources



- Supplement notes

- Toxicity only likely from supplements: irregular heart beat, nausea, diarrhoea, appetite loss, extremely low blood pressure.

# Iodine

- Main function
  - Thyroid hormone production
- Absorption
  - Most iodine in table salt is absorbed.
  - In unfortified foods, absorption is around 20%.
- Losses
  - Loss through urine is main means of regulating body levels of iodine.

# Iodine

- Deficiency symptoms
  - Spontaneous abortion and birth defects, irreversible impairment in brain and physical development in foetus and young child.
  - Adults: goitre; slows metabolic rate, mental and cardiac function; induces feeling of fatigue and cold intolerance.

# Iodine

- Food sources



- Supplement notes

- Wolf-Chaikoff effect: ingestion of a large dose of iodine, rapidly decreases thyroid hormone production. Avoid sudden increases in iodine intake (seaweed snacks).

# Iron

- Main function
  - Oxygen transport
- Other functions
  - Energy production in mitochondria
  - Free radical metabolism – excess is detrimental
  - DNA synthesis
  - Alcohol metabolism
  - Thyroid hormone metabolism

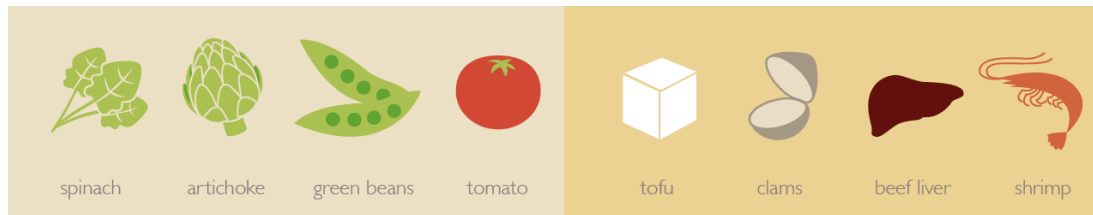
# Iron

- Absorption
  - Several mechanisms of absorption.
  - Improved by vitamin C.
  - Decreased by tannins, caffeine, phytates, fibre.
  - 14-18% from mixed diet and 5-12% vegetarian diet.
- Losses
  - Lost through bile, skin and urine, menses (women).
  - Often ignored: intestinal blood loss via digestive system often caused by worm infection.



# Iron

- Food sources



- Deficiency

- Anaemia, impaired immune function.
- In children slows growth and cognitive development.

- Supplementation

- Can interfere with absorption of medications including thyroid medication, some antibiotics and Parkinson's medications.

# Zinc

- Main function
  - Cofactor for several hundred enzymes, 16% of all enzymes need zinc.
  - DNA replication and function
  - Cofactor for enzymes that digest food (including alcohol)
  - Immune function
- Other functions
  - Free radical metabolism (Antioxidant enzymes SOD)

# Zinc

- Absorption
  - More than 70% of small doses of zinc are absorbed.
  - Mostly unaffected by the presence of other minerals.
- Losses
  - 2-10% lost via urine

# Zinc

- Food sources



- Supplement notes

- Excessive intake may deplete copper stores, impair immune function and lower HDL levels.

Thank you!



Questions?

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