

Structure and functions in living organisms

Cells and organisation

Levels of organisation

Organelles Cells Tissues Organs Organ systems

Animal cell

Nucleus Cytoplasm Cell membrane Mitochondria

Plant cell extras

Cell wall Chloroplasts Vacuole

Ribosomes make protein

Differentiation **Biology only**

Specialised cells Structure matches function

Stem cells in medicine **Biology only**

Replace damaged cells Tumour risk Rejection Ethics

Molecules and enzymes

Elements

Carbs: C H O Lipids: C H O Protein: C H O N

Building blocks

Sugars to starch, glycogen Amino acids to protein

Fatty acids + glycerol to lipid

Food tests

Benedict's: glucose Iodine: starch Biuret: protein

Ethanol: fat

Enzymes

Biological catalysts Active site Specific

Temperature

Optimum Denatured Active site shape

pH

Optimum pH Extreme pH denatures

Amylase practicals

Iodine in spotting tile Water bath Buffers for pH

Movement into and out of cells

Diffusion

Down concentration gradient Passive

Osmosis

Water only Partially permeable membrane

Dilute to concentrated

Active transport

Against gradient Needs respiration energy

Rate factors

Surface area : volume Distance Temperature

Concentration gradient

Practicals

Potato cylinders Visking tubing Agar cubes

Percentage change in mass

Plant nutrition

Photosynthesis

light → chemical energy $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{glucose} + \text{O}_2$

Rate

light intensity CO_2 concentration temperature

Leaf structure

palisade mesophyll spongy mesophyll stomata

transparent epidermis

Leaf gas exchange **Biology only**

thin: short distance flat: large surface area many stomata

air spaces, moist surfaces

Mineral ions

magnesium: chlorophyll nitrate: amino acids

Pondweed practical

bubbles per minute lamp distance heat shield

Starch practical

destarch boil, ethanol, iodine foil, soda lime, variegated

Human nutrition

Balanced diet

seven components activity, age, pregnancy

Nutrients

vitamins A, C, D calcium, iron water, fibre

Alimentary canal

mouth to anus pancreas peristalsis

Digestive enzymes

amylase, maltase proteases lipases

Bile

liver, gall bladder neutralises acid emulsifies lipids

Absorption

villi, microvilli one cell thick capillaries, lacteal

Food energy practical **Biology only**

burn food under water mass × 4.2 × change

Respiration

Releases energy to make ATP

Glucose broken down ADP + phosphate → ATP

ATP provides energy

Muscle contraction Active transport Making proteins

Aerobic respiration

Needs oxygen Glucose + oxygen → CO_2 + water

$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$

Anaerobic respiration

No oxygen Animals: lactic acid Plants: ethanol + CO_2

Aerobic releases more energy

Practical: respiring seeds

Heat: vacuum flasks CO_2 : indicator or limewater

Boiled seeds control

Gas exchange in plants

Waste products

CO_2 : from respiration O_2 : from photosynthesis

Leave by stomata

Diffusion down gradient **Biology only**

Guard cells control stomata **Biology only**

Net gas exchange **Biology only**

Dark: CO_2 released Compensation point: none

Bright: CO_2 taken in

Practical: indicator **Biology only**

Red/orange: normal Yellow: more CO_2 Purple: less CO_2

Gas exchange in humans

Thorax structures

Ribs and intercostals Diaphragm Trachea and bronchi

Pleural membranes

Breathing in

Muscles contract Volume up, pressure down

Breathing out

Muscles relax Volume down, pressure up

Alveoli adaptations

Large surface area Thin walls Good blood supply

Moist lining

Smoking

Tar: cilia, cancer Carbon monoxide Nicotine

Emphysema, CHD

Practical: breathing

Limewater test Breathing rate and exercise

Transport in plants

Why transport is needed

Small SA : volume ratio Long diffusion distance

Xylem

Water and mineral ions Dead, lignified tubes

Phloem

Sucrose and amino acids Living cells

Root hair cells **Biology only**

Osmosis for water Large surface area

Transpiration **Biology only**

Evaporation from leaf Transpiration stream

Factors and potometer **Biology only**

Humidity, wind, temperature, light Bubble distance ÷ time

Blood and immunity

Composition of blood

Red and white cells Platelets Plasma

Plasma transports

CO₂, urea, hormones Digested food, heat

Red blood cells

Biconcave shape No nucleus Haemoglobin

Immune response

Phagocytes ingest Lymphocytes release antibodies

Vaccination Biology only

Memory cells Sooner, faster, greater

Clotting Biology only

Fibrinogen to fibrin Stops blood loss and entry

Coordination and plants

Responding to change

Stimulus Receptor Effector

Animal and plant responses

Nervous system Hormones Plant growth

Homeostasis

Constant internal environment Body water content

Body temperature

Tropisms

Phototropism Geotropism

Shoots and roots

Shoot: towards light, up Root: away from light, down

Auxin

Made in shoot tip Moves to shaded side Cells elongate

Heart and circulation

Heart structure

Atria and ventricles Septum and valves

Heart rate

Increases in exercise Adrenaline

Coronary heart disease

Narrowed coronary arteries Risk factors

Arteries

Thick wall High pressure

Veins

Wide lumen Valves

Capillaries

One cell thick Exchange

Circulation system

Double circulation Liver and kidney vessels

Nervous system and eye

CNS

Brain Spinal cord Nerves link sense organs

Synapse

Neurotransmitter Diffuses across gap Binds to receptors

Reflex arc

Receptor Sensory neurone Relay neurone

Motor neurone

Eye structure

Cornea refracts Lens focuses Retina: rods and cones

Optic nerve

Focusing

Near: lens thicker Distant: lens thinner Ciliary muscles

Pupil reflex

Bright: circular contract Dim: radial contract

Excretion

Organs of excretion

Lungs: carbon dioxide Skin: water, salts, urea

Kidneys: urea in urine

Urinary system Biology only

Kidney Ureter Bladder Urethra

Nephron structure Biology only

Bowman's capsule, glomerulus Convoluted tubules

Loop of Henle Collecting duct

Ultrafiltration Biology only

High pressure Small molecules pass

Proteins stay in blood

Selective reabsorption Biology only

Glucose at proximal tubule Active transport

Water by osmosis at collecting duct

Urine contents Biology only

Water Urea Ions

ADH Biology only

Pituitary gland Collecting duct permeability

Water content of blood

Hormones and temperature

Nervous vs hormonal

Impulses vs blood Fast vs slower Short vs longer

Adrenaline

Adrenal glands Fight or flight Heart rate up

Insulin

Pancreas Glucose to glycogen

Sex hormones

Testosterone: testes Oestrogen: ovaries

Progesterone: ovaries

ADH, FSH, LH Biology only

Pituitary gland ADH: water reabsorbed FSH: egg matures

LH: ovulation

Skin

Sweating Vasodilation Vasoconstriction