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| <p>Integration of body systems</p> <p><b>What is system integration?</b></p>                       | <p>Integration of body systems</p> <p><b>Emergent property (with the IB example)</b></p>                            |
| <p>Integration of body systems</p> <p><b>Name three ways organs are integrated in animals.</b></p> | <p>Integration of body systems</p> <p><b>What two roles of the brain make it the central integration organ?</b></p> |
| <p>Integration of body systems</p> <p><b>Conscious vs unconscious processes</b></p>                | <p>Integration of body systems</p> <p><b>Sensory neuron vs motor neuron</b></p>                                     |
| <p>Integration of body systems</p> <p><b>What does a transverse section of a nerve show?</b></p>   | <p>Integration of body systems</p> <p><b>Pain reflex arc, in order</b></p>                                          |

A property of the whole that its parts lack, arising from integration. A cheetah is an effective predator through integration of its body systems.

Coordination of the component parts of a system so that they collectively perform an overall function. It is a necessary process in living systems.

Processing information combined from several inputs, and learning and memory.

Nervous signalling, hormonal (endocrine) signalling, and transport of materials and energy by the blood.

Sensory: carries messages from receptor cells to the CNS. Motor: carries output from the CNS (cerebral hemispheres) to muscles, stimulating contraction.

Conscious: aware and voluntary, coordinated by cerebral hemispheres.  
Unconscious: no awareness or decision (eg reflexes), can be coordinated by the spinal cord.

Free nerve ending in hand → sensory neuron → interneuron in spinal cord grey matter → motor neuron → skeletal muscle contracts.

A protective sheath around bundles of nerve fibres of both sensory and motor neurons, some myelinated and some unmyelinated.

Integration of body systems

**What is the effector in a pain reflex arc?**

Integration of body systems

**Role of the cerebellum**

Integration of body systems

**Melatonin: source and pattern**

Integration of body systems

**Four effects of epinephrine**

Integration of body systems

**How do the hypothalamus and pituitary control the endocrine system?**

Integration of body systems

**Baroreceptors: what and where?**

Integration of body systems

**How does the medulla change heart rate?**

Integration of body systems

**Why does blood pH fall during exercise?**

Coordinates skeletal muscle contraction and balance, giving smooth, accurate movement and posture.

A skeletal muscle, which contracts to withdraw the body part.

Increased heart rate and stroke volume; blood diverted to skeletal muscles; airways widen and ventilation increases; liver glycogen broken down to glucose.

Secreted by the pineal gland; rises in the evening darkness, high at night, low in daylight. Helps set the sleep-wake cycle.

Monitor blood pressure; located in the walls of the aortic arch and carotid arteries.

The hypothalamus receives nervous and blood-borne information and signals the pituitary, which secretes hormones that regulate other endocrine glands.

More CO<sub>2</sub> from respiration forms carbonic acid, which releases H<sup>+</sup> ions.

Impulses along the sympathetic nerve increase heart rate and stroke volume; impulses along the vagus nerve decrease heart rate.

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| <p>Integration of body systems</p> <p><b>Effectors in ventilation control</b></p>                                        | <p>Integration of body systems</p> <p><b>Which parts of gut movement are voluntary?</b></p>                                              |
| <p>Integration of body systems</p> <p><b>Enteric nervous system (ENS)</b></p>                                            | <p>Integration of body systems <b>HL only</b></p> <p><b>Positive phototropism</b></p>                                                    |
| <p>Integration of body systems <b>HL only</b></p> <p><b>Qualitative and quantitative data in tropism experiments</b></p> | <p>Integration of body systems <b>HL only</b></p> <p><b>How can precision and reliability of curvature measurements be improved?</b></p> |
| <p>Integration of body systems <b>HL only</b></p> <p><b>Phytohormones</b></p>                                            | <p>Integration of body systems <b>HL only</b></p> <p><b>Role of auxin efflux carriers</b></p>                                            |

Initiation of swallowing and egestion of faeces, controlled by the CNS. Peristalsis in between is involuntary.

The diaphragm and intercostal muscles, signalled by the medulla after chemoreceptors in the brainstem detect a fall in pH.

A directional growth response to lateral light in plant shoots: the shoot grows towards the light.

Network of neurons in the gut wall that controls peristalsis involuntarily, coordinating passage of material through the gut.

Photograph seedlings and measure angles with software or against a grid; use many seedlings, repeat and calculate means.

Qualitative: diagrams of seedling shape and direction of bending. Quantitative: angle of curvature measured in degrees.

Pump auxin out of cells. Concentrated on the same side of every cell, they actively transport auxin through tissue and create concentration gradients.

Signalling chemicals controlling growth, development and response to stimuli in plants, eg auxin, cytokinins, gibberellins, abscisic acid, ethylene.

Integration of body systems **HL only**

**How does auxin promote cell growth?**

Integration of body systems **HL only**

**Where are auxin and cytokinin made and sent?**

Integration of body systems **HL only**

**Effect of the auxin to cytokinin ratio**

Integration of body systems **HL only**

**Ethylene and fruit ripening**

Defence against disease

**Pathogen**

Defence against disease

**Which group of organisms is not known to cause disease in humans?**

Defence against disease

**How is skin a physical and a chemical barrier?**

Defence against disease

**How do mucous membranes defend the body?**

Shoot tips make auxin, transported to roots.  
Root tips make cytokinin, transported to shoots. Their interaction integrates root and shoot growth.

Promotes  $H^+$  secretion into the apoplast, acidifying the cell wall and loosening cross links between cellulose molecules, so the cell elongates.

Ethylene stimulates ripening and ripening stimulates more ethylene: positive feedback, making ripening rapid and synchronized.

High auxin to cytokinin favours root growth (lateral roots); low ratio favours shoot growth (side buds released from apical dominance).

Archaea.

A disease-causing organism; the term is typically reserved for viruses, bacteria, fungi and protists.

Sticky mucus traps pathogens; in airways, cilia sweep it away; lysozyme in mucus digests bacterial cell walls.

Physical: tough outer layer of dead keratinized cells. Chemical: acidic secretions with antimicrobial chemicals that inhibit bacteria and fungi.

Defence against disease

**Blood clotting, in order**

Defence against disease

**Innate vs adaptive immune system**

Defence against disease

**How do phagocytes control infection?**

Defence against disease

**Where are lymphocytes found?**

Defence against disease

**Antigen**

Defence against disease

**Why can a blood transfusion trigger  
antibody production?**

Defence against disease

**What two things activate a B-cell?**

Defence against disease

**Plasma cells**

Innate: broad categories of pathogen, unchanged through life. Adaptive: specific to particular pathogens, builds memory so responses improve.

Platelets release clotting factors → cascade → thrombin → fibrinogen converted to fibrin → fibrin mesh traps erythrocytes → clot.

Circulating in the blood and contained in lymph nodes.

Amoeboid movement from blood to infection site, recognize pathogens, engulf them by endocytosis, digest them with lysosome enzymes.

Antigens on donated erythrocytes from a different blood group are recognized as foreign and stimulate antibody production.

A recognition molecule that triggers antibody production; usually a glycoprotein or other protein on the outer surface of a pathogen.

Antibody-secreting cells formed when activated B-cells divide by mitosis; a clone all making the same antibody.

Direct interaction with its specific antigen, and contact with a helper T-cell activated by the same antigen.

Defence against disease

## **Immunity**

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## **What do vaccines contain?**

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## **Herd immunity**

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## **Four ways HIV is transmitted**

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## **Why does HIV infection lead to AIDS?**

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## **Why do antibiotics not harm human cells?**

Defence against disease

## **How does antibiotic resistance spread?**

Defence against disease

## **How can careful use slow multiresistant bacteria?**

Antigens, or nucleic acids (DNA or RNA) with sequences coding for antigens. They stimulate immunity without causing the disease.

The ability to eliminate an infectious disease from the body, due to long-term survival of memory cells that make the specific antibodies.

Unprotected sex; sharing needles; unscreened blood transfusions; mother to baby via placenta, childbirth or breast milk.

When a sufficient percentage of a population is immune, transmission is greatly impeded, preventing epidemics and protecting non-immune people.

They block processes found in bacteria but not eukaryotic cells, eg cell wall synthesis or protein synthesis by 70S ribosomes.

HIV kills helper T-cells, so fewer B-cells are activated and fewer antibodies made; opportunistic infections cannot be fought.

Prescribe only for bacterial infections, complete the course, limit use in livestock, and maintain hospital hygiene.

Mutation or plasmid gives resistance; antibiotic kills susceptible bacteria; resistant ones survive and reproduce: natural selection.

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**Zoonosis (with IB examples)**

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**How are rabies and Japanese encephalitis transmitted?**

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**Percentage change vs percentage difference**

Rabies: bite from an infected mammal (virus in saliva). Japanese encephalitis: bite of a mosquito that fed on infected pigs or birds.

An infectious disease that can transfer from other species to humans, eg tuberculosis, rabies, Japanese encephalitis, COVID-19.

Change:  $(\text{final} - \text{initial}) \div \text{initial} \times 100$ , one quantity over time, with a sign. Difference:  $|A - B| \div \text{mean of A and B} \times 100$ , two values with no starting point.