

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

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.

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What is the effector in a pain reflex arc?

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Role of the cerebellum

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Melatonin: source and pattern

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Four effects of epinephrine

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How do the hypothalamus and pituitary control the endocrine system?

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Baroreceptors: what and where?

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How does the medulla change heart rate?

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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 CO₂ from respiration forms carbonic acid, which releases H⁺ ions.

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

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

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.

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How does auxin promote cell growth?

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Where are auxin and cytokinin made and sent?

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Effect of the auxin to cytokinin ratio

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Ethylene and fruit ripening

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).