Harvard Undergraduate Science Olympiad 2026
Open Round
Biology Syllabus: 9th - 10th

Potential Topics Covered on the Exam:
Please note that not necessarily every topic on this list will be on the exam, don't get overwhelmed! The syllabus is meant to be exhaustive of all *potential* topics that could be on the exam. For students, a great place to start is with making sure you're comfortable with the ICSE curriculum for 9th-10th grade. It will be a difficult exam, but remember you don't need to (nor do we expect you) get a 100%! Just do your best and show us all that you've learned! Good luck and happy studying!

The content below mirrors content found on the INBO exam.

Biochemical Structures
- Carbon as the basis of life
- Nucleic Acids, Lipids, Proteins, Carbohydrates

Cell Biology:
- Molecular Biology:
  - Central Dogma: DNA, RNA, Proteins
  - Processes: Transcription, RNA Processing, Translation, DNA replication
- The Cell:
  - The Cell Theory of Life, components of cells, structure and function of cellular organelles, function of compartmentalization
    - Organelles to know: Nucleus, cytoplasm, ribosome, chloroplast, mitochondria, endoplasmic reticulum, golgi, lysosome, cell membrane, vacuole, cell wall, peroxisome, centriole, cytoskeleton.
  - Differences between prokaryotic and eukaryotic cell; differences between an animal and a plant cell.
  - Use of microscopy to view cells
  - Cell division (mitosis, meiosis)
- Photosynthesis

- Definition, overall reaction process, factors affecting photosynthesis: (light, carbon dioxide, water, chlorophyll), significance of photosynthesis, setup.
- Experiment to demonstrate photosynthesis process.

- Cellular Respiration
  - Definition, overall reaction process; respiration as a process which releases energy; respiration in plants: two types (aerobic and anaerobic: basic concept, word equations for both, examples).
  - Respiration and photosynthesis in plants, differences in both processes.

Animal Anatomy & Physiology:

- Animal Tissues
  - Epithelial tissue: simple location, and function (types of epithelial tissue not to be mentioned).
  - Connective tissue location and functions of bone, cartilage, blood, ligament, tendon.
  - Muscular tissue: location and one function of:
    - striated (voluntary or skeletal muscle),
    - unstriated (involuntary/ smooth muscle),
    - cardiac (specialized muscle).
- Digestive System
  - Organs, digestive glands and their functions
  - Nutrition: Classes of food; balanced diet. Malnutrition and deficiency diseases
- Respiratory System
  - Organs; mechanism of breathing; tissue respiration, heat production.
- Excretory System
  - Organs and their excretory products (kidneys, sweat glands, lungs);
  - Renal Excretory System – kidneys, ureter, urinary bladder, urethra (location and functions to be explained along with diagram);
  - Role of kidneys infiltration of blood through millions of nephrons (structure of nephron NOT to be discussed)
- Nervous System
  - Main parts: brain, spinal cord, nerves.
  - Central nervous system (CNS) parts and their functions.
    - Brain: cerebrum, cerebellum, medulla oblongata (location and function).
    - Spinal cord: location and function.
  - Types of nerves: sensory, motor, mixed (function only).
  - Structure of a motor neuron
  - Reflex action: definition and basic terms used to describe reflex action stimulus, response, impulse, receptor, effector); common examples of reflex action.
- Immune System
  - Difference between innate and adaptive immunity
  - Function of B and T cells
    - Function of antibodies
  - Concept of allergy.
    - Allergens: Common allergens like dust, pollen grain, mites, strong sunlight, particular food items.
    - Entry routes of allergens
    - Symptoms of allergic reaction

- Endocrine System
    - Two types of glands- exocrine, endocrine (basic concept and difference)
    - Hormone (definition)
    - Hormonal glands – (limited to thyroid, adrenal, pancreas, pituitary)
        - Following points to be studied in tabular form: name of the gland, location in body, secretion, function.
- Circulatory System
    - Internal structure of heart (including valves, septum).
    - Schematic diagram of the heart and double circulation
    - Blood vessels – aorta, pulmonary trunk, coronary artery & vein, vena cava.
    - Blood Groups (A, B, AB and O): universal donor and universal acceptor.
    - Conditions related to the functioning of the heart: palpitations, cardiac arrest and hypertension.
    - Introduction of lymphatic system as a parallel circulatory system.

Ecology:

- Understanding ecosystems: definition, interaction between biotic and abiotic factors.
- Biotic components consisting of producers, consumers, decomposers.
- Meaning of food chain. Food web, and pyramid of numbers.
- Interdependence between organisms: symbiosis, parasitism and predation.
- Abiotic components such as air, soil, water and climatic factors such as sunlight, temperature, humidity and wind

Biosystematics:

- Meaning and concept of classification
- Need and advantages of Classification
- Characteristics of each kingdom
    - Monera: bacteria – shape; organelles; movement
    - Protista: Amoeba – basic structure and life processes (nutrition, locomotion, respiration, excretion and reproduction – by binary and multiple fission).
    - Fungi: basic structure of mould, nutrition and respiration in mould.
    - Plantae: characteristics and examples (classification of plantae NOT to be tested).
    - Animalia
        - Vertebrates.
        - Invertebrates

Preparation for Exam:

- **Campbell Biology**: Gold standard textbook for general biology knowledge. Most knowledge tested on the exam will be based on information from this textbook.
    - Each chapter also comes with a review summary and practice questions.

Note that reading Campbells is not the only way to prepare. Other possible methods to prepare include watching relevant biology videos on YouTube and doing practice problems (see below).

Sample Questions:

Example questions of comparable difficulty can be found on Biology Olympiad Open Round questions from past INBO and USABO exams:

- See past INBO and past USABO exams (Opens only).
- AP Biology resources and practice questions are also a great resource (see Khan Academy)