



## Harvard Undergraduate Science Olympiad India 2024

### Open Round

### Biology Syllabus: 7th - 8th

**Reference Material:** No reference material will be provided for the Biology section.

#### **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. A great place to start is with making sure you're comfortable with the ICSE curriculum for 7th-8th 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!*

#### **Advanced Topics:**

For those looking to further challenge themselves, below **in red** are more advanced topics that may also be tested. Students are encouraged to first learn the topics not in red before tackling these.

#### **Cell Biology:**

- The cell:
  - Unit of life, protoplasm, difference between prokaryotic and eukaryotic cell; differences between an animal and a plant cell.
  - Use of microscopy to view cells
  - Structure and function of cellular organelles, function of compartmentalization
  - Understand mitosis vs. meiosis
- Photosynthesis
  - Definition, basic process, factors affecting photosynthesis: (light, carbon dioxide, water, chlorophyll), significance of photosynthesis, setup.
  - **Experiment to demonstrate photosynthesis process.**
- Respiration
  - Basic process, word equation; 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, difference in both processes.

## Plant Anatomy & Physiology:

- Classification, structure, and function of plant tissues:
  - Meristematic tissues: characteristics, simple structure, location, function, examples.
  - Simple permanent tissues: parenchyma, collenchyma, sclerenchyma, examples.
  - Complex permanent tissues: xylem and phloem
- Diffusion – definition
- Osmosis – definition, example, semipermeable membrane, root pressure; active transport.
- Transpiration – definition, importance and factors affecting transpiration.
- Importance of minerals: macronutrients (limited to nitrogen, phosphorus, and magnesium).
  - **Deficiency diseases caused by lack of these macronutrients**
- Asexual reproduction in Plants:
  - Binary fission, budding, fragmentation, spore formation, vegetative propagation, artificial propagation by tissue culture (basic process along with a suitable example of each)
- Sexual reproduction in Plants:
  - Review of parts of a typical flower (4 whorls and their structure and function)
  - Pollination: self and cross; Agents of pollination: characteristics of plants pollinated by insects, water, and wind (with examples).
  - Fertilization process.

## 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.

### Genetics:

- Mendelian genetics: Punnett squares, phenotype vs. genotype, monohybrid and dihybrid crosses
- Non-mendelian genetics: Incomplete dominance and codominance
- Chromosomal basis of inheritance: law of segregation and independent assortment
- Structure of DNA (including discovery), DNA vs. RNA, Chargaff's rules

### 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: **9 major Phyla; (Porifera, Cnidaria, Coelenterata, Platyhelminthes, nematoda, Annelida, Arthropoda, Mollusca, Echinodermata)**

### **Biology Applications:**

- Food Production
  - Bacteria: uses of bacteria in the food industry.
  - Fungi – Importance of yeast in the food industry.
  - Agriculture: cultivated crops (food crops and cash crops), crops grown in India.
- Diseases
  - The meaning of vector.
  - Method of preventing diseases in general:
    - Vaccination and immunization: the concepts and difference between the two.
  - A brief idea of communicable diseases (limited to influenza, measles, malaria, dengue, chikungunya, HIV)
    - **Causative agents, symptoms, and prevention to be dealt with in a tabular form.**

### **Preparation for Exam:**

The Byjus website has links to textbooks for ICSE Class 8 and ICSE Class 9 biology. Note that none of these books are not required to prepare for the exam, nor are they 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:**

Exam questions on HUSO India will require greater synthesis and application of knowledge than on the ICSE Exams. Example questions of comparable difficulty can be found from past INJSO exams:

- 2023 INJSO [Exam](#) + [Key](#)
- 2022 INJSO [Exam](#) + [Key](#)

More sample questions can be found at [past INJSO](#) exam compilation.