

December 2013

**Syllabus for Basic Academic Abilities in the EJU**

(To be applied to the questions of the 2015 EJU 1st Session (June))

## &lt;Syllabus of Science&gt;

**[Purpose of the Examination]**

The purpose of this examination is to test whether international students have the basic academic ability in science necessary for studying at universities or other such higher educational institutions in Japan.

**[Classification of Examination]**

The examination consists of three subjects, i.e. physics, chemistry, and biology; examinees will select two of these subjects.

**[Scope of Questions]**

The scope of questions is as follows. What is taught in elementary and junior high schools is regarded to have been already learned and therefore is to be included in the scope of the EJU. What questions consists of in each subject is classified into categories, each of which is presented by topics and scientific terms.

**Biology**

The scope of questions will follow the scope of “Basic Biology” and “Advanced Biology” of the Course of Study for high schools in Japan.

**I Biological Phenomena and Substances**

## 1. Cells and molecules

## (1) Biological substances and cells

Organelle

Prokaryotic and eukaryotic cells

Cytoskeleton

## (2) Biological phenomena and proteins

Protein structure

Protein function [Example] enzyme

## 2. Metabolism

## (1) Life activities and energy

ATP and its role

## (2) Respiration [Example] glycolytic pathway, citric acid cycle, electron transport system, fermentation and glycolysis

## (3) Photosynthesis [Example] photosystem I, photosystem II, Calvin-Benson cycle, electron transport system

## (4) Bacterial photosynthesis and chemosynthesis

## (5) Nitrogen assimilation

## 3. Genetic information and its expression

- (1) Genetic information and DNA
  - Double-helix structure of DNA
  - Gene, chromosome and genome
- (2) Segregation of genetic information
  - Segregation of genetic information by somatic cell division
  - Cell cycle and DNA replication
  - Mechanism of DNA replication
- (3) Expression of genetic information
  - Mechanism of gene expression [Example] transcription, translation, splicing,
  - Changes in genetic information [Example] gene mutation
- (4) Control of gene expression
  - Regulation of transcriptional level
  - Selective gene expression
  - Cell differentiation by gene expression control
- (5) Biotechnology [Example] genetic transformation, gene transfer

## **II Reproduction and Generation**

1. Sexual reproduction
  - (1) Meiosis and fertilization
    - Gene segregation by meiosis
    - Genetically diverse combination by fertilization
    - Sex chromosomes
  - (2) Genes and chromosomes
    - Genetic linkage and gene recombination
    - Chromosomal crossing-over and gene recombination
2. Animal development
  - (1) Animal gametogenesis and fertilization
  - (2) Early developmental process in animals
  - (3) Cell differentiation and morphogenesis in animals
3. Plant development
  - (1) Plant gametogenesis, fertilization and embryogenesis
  - (2) Organ differentiation in plants [Example] floral morphogenesis

## **III Homeostasis of the internal environment in living organisms**

1. The internal environment in living organisms
  - (1) Fluid movement in the circulatory system
  - (2) The composition of body fluid and its concentration control
  - (3) Mechanism of blood coagulation
2. Homeostatic mechanism of the internal environment in living organisms
  - (1) Internal regulation by autonomic nerves and hormones [Example] control of blood glucose level

3. Immunity

- (1) Cells in immune system
- (2) Mechanism of immune system

**IV Organisms' response to external signals**

1. Reactions and actions of animals to external signals

- (1) Perception and response to stimulus
  - Sensory receptors and their functions
  - Effectors and their functions
  - Nervous systems and their functions
- (2) Animal behavior

2. Plant responses to external signals

- (1) Functions of plant hormones [Example] functions of auxins, functions of gibberellins
- (2) Functions of plant photoreceptors [Example] functions of phytochrome

**V Ecology and Environment**

1. Populations and communities

- (1) Populations
  - Populations and their structures
  - Interaction within populations
  - Interaction among populations
- (2) Communities
  - Communities and their structures

2. Ecosystems

- (1) Matter production and cycle of matter in ecosystems
  - [Example] food web and trophic level, carbon cycle and flow of energy, nitrogen cycle
- (2) Ecosystems and biodiversity
  - Genetic diversity
  - Species diversity
  - Diversity of ecosystems
  - Ecological balance and conservation
- (3) Diversity and distribution of vegetation [Example: succession of vegetation]
- (4) Climates and biomes

**VI Biological Evolution and Phylogeny**

1. Mechanism of biological evolution

- (1) Origin of life and transition of organisms
  - Beginning of life
  - Evolution of organisms
  - Human evolution

(2) Mechanism of evolution

Variation between individuals (mutation)

Changes in gene frequency and its mechanism

Molecular evolution and neutral evolution

Species differentiation

Coevolution

2. Phylogeny of organisms

(1) Phylogenetic classification of organisms [Example] Comparison of DNA base sequence

(2) Higher taxa and phylogeny