

**1999**

The College Board  
Advanced Placement Examination

**BIOLOGY**  
**SECTION II**

Time—1 hour and 30 minutes

Number of questions—4

Percent of total grade—40

Answer all questions. Number your answer as the question is numbered below.

Answers must be in essay form. Outline form is NOT acceptable. Labeled diagrams may be used to supplement discussion, but in no case will a diagram alone suffice. It is important that you read each question completely before you begin to write.

1. The rate of photosynthesis may vary with changes that occur in environmental temperature, wavelength of light, and light intensity. Using a photosynthetic organism of your choice, choose only ONE of the three variables (temperature, wavelength of light, or light intensity) and for this variable
  - **design** a scientific experiment to determine the effect of the variable on the rate of photosynthesis for the organism;
  - **explain** how you would measure the rate of photosynthesis in your experiment;
  - **describe** the results you would expect. **Explain** why you would expect these results.
2. Communication occurs among the cells in a multicellular organism. Choose THREE of the following examples of cell-to-cell communication, and for each example, **describe** the communication that occurs and the types of responses that result from this communication.
  - Communication between two plant cells
  - Communication between two immune-system cells
  - Communication **either** between a neuron and another neuron, **or** between a neuron and a muscle cell
  - Communication between a specific endocrine-gland cell and its target cell

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**Question 1**

A. **Experimental Design:** The following experimental characteristics may earn 1 point each. (Max 7 points)

- Score only the **1st** independent variable (temperature, wavelength, intensity) manipulated, and the **1st** factor used by the student to measure photosynthetic rate (O<sub>2</sub>, CO<sub>2</sub>, etc.).
- A 3 point maximum in Section A if the experiment will not work biologically. Examples: using an organism that is not photosynthetic, or using an apparatus that biologically will not measure photosynthesis as designed (i.e. potometer or respirometer). Not intended to mean a technical design flaw.

- State **hypothesis** (clear statement of a hypothesis, identifies it as a hypothesis, uses "If/then" statement)
- Specify a **control group** for comparison
- Identify and **hold constant at least one experimental factor** that can affect photosynthetic rate
- **Manipulate the independent variable** (change the temperature, wavelength of light, intensity of light)
- Describe **what is being measured** to determine rate (CO<sub>2</sub> or H<sub>2</sub>O consumption, O<sub>2</sub> or carbohydrate production, growth, e<sup>-</sup> flow measured with dye reduction, production of an intermediate product, etc.)
- **Quantify** the measurement of the variable (method & time frame of measurement)
- **Rate** calculation or definition
- **Verify** results through sample size (>1) or repetition
- Utilize **statistical application** of data (mean, t-test, ANOVA, etc.)
- Design an **exemplary** experiment

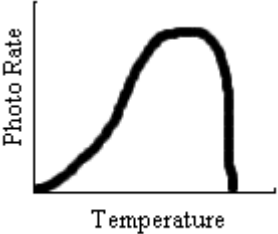
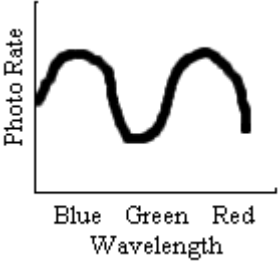
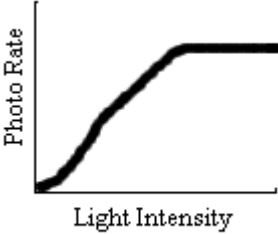
B. **Describe expected experimental results** (Max 2 points)

- Verbal or graphic description of expected experimental results (1 point)

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**Question 1 (cont.)**

- Verbal or graphic description of expected results across the entire range of biological activity (1 point)
- The graphs below represent 2-point graphs, but to earn **any** points, graphs must be accurately labeled

Temperature	Wavelength	Intensity
Rate rises with temperature to an optimum and then falls	An "action spectrum" with highest rates in the blue and red regions of the spectrum	Rate increases steadily to a maximum and levels off
		

**C. Biological explanation of results (Max 3 points)**

**Temperature**

- Enzyme kinetics or metabolic changes
- Enzyme denatures
- Photorespiration
- Stomatal closing w/high temp, limits CO<sub>2</sub> & lowers rate
- Excessive water loss, less reactant available for reaction
- Elaboration

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**Question 1 (cont.)**

Wavelength

- Absorption/reflection of light by chlorophyll
- Accessory pigments absorbing green light
- Relation between wavelength & energy
- Elaboration

Intensity

- More photons hit photosystems
- More  $e^-$  flow in the electron transport system/time
- Plateau caused by limiting factors
- Elaboration