CollegeBoard AP

AP® Biology
2009 Scoring Guidelines
Form B

The College Board

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Question 1

Describe how a plasmid can be genetically modified to include a piece of foreign DNA that alters the phenotype of bacterial cells transformed with the modified plasmid. **Describe** a procedure to determine which bacterial cells have been successfully transformed.

Describe plasmid modification (8 points maximum):

Topic	Description (1 point each)
Plasmid vector	Describes plasmid as small circular DNA
Cut (cleave) DNAs	Use of restriction endonucleases (RE) Plasmid and inserted DNA must have same RE cut ends or be cut by same RE
Sticky ends	Ends of DNA should be sticky, wanting to bond with matching ends Generate ends for attachment using endonucleases
Ligase	For joining of sticky ends
Orientation	Correct orientation of insertion to ensure expression
Gene of interest	DNA cut should be a complete sequence of gene Attach piece with a promoter or insert next to promoter
Reporter gene	Gene used to identify insertion of desired DNA Insert DNA with a gene that produces a new phenotype
Selective marker	Inserted to help identify the DNA insertion (e.g., antibiotic resistance)
AUG in place	Ensure proper start codon
Uptake of plasmid	Calcium chloride and heat shock, electroporation to make competent
Alternative procedures	Blunt cuts; T4 ligase; add terminal transferase to add poly (A) to 3′ end

Describe plasmid uptake and how transformation is **determined (6 points maximum)**:

Topic	Description (1 point each)
Transformation	Defined process of transformation of a plasmid
Isolation	Isolate plasmids/agar plate that grows only colonies of resistance gene
Antibiotic	Use of antibiotic resistance/sensitivity genes Detailed description of antibiotic resistance lab procedure
Gel electrophoresis	Isolate plasmid using electrophoresis Detailed description of gel electrophoresis for isolation
Retrieval	Retrieve altered plasmid
Protein	Identification of new protein, possible glowing marker protein Detailed description of retrieval or protein method
Tag	Fluorescent marker, etc. Detailed description of alternate method

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Question 2

Discuss the patterns of sexual reproduction in plants. **Compare** and **contrast** reproduction in nonvascular plants with that in flowering plants. **Include** the following topics in your discussion:

(a) alternation of generations
(b) mechanisms that bring female and male gametes together
(c) mechanisms that disperse offspring to new locations

Four points per part. Student must write about all three parts for full credit. Within each part it is possible to get points for comparing and contrasting. Also, specific points are available from details provided about nonvascular and flowering plants.

Discuss the patterns of sexual reproduction in plants **(4 points maximum)**:

(a) Alternation of generations (**4 points maximum)**:

Topic	Description (1 point each)
Alternating generations	Haploid stage and diploid stage.
Gametophyte	Haploid-producing gametes. Dominant in nonvascular plants. Double fertilization in flowering plants. Gametangia; archegonia and antheridia in nonvascular plants.
Sporophyte	Diploid-producing spores. Heterosporous in flowering plants. Flowering plants produce seeds; nonvascular plants do not. Flowering plants produce flower structures. Sporangia (megasporangia and microsporangia). Dominant in flowering plants.

(b) Mechanisms that bring female and male gametes together **(4 points maximum)**:

Nonvascular Plants (1 point each)	Flowering Plants (1 point each)
Aquatic—requires water for motile sperm	Terrestrial—pollination by wind, water, or animal
	Micropyle in ovule for pollen tube to enter
	Pollen tube to carry sperm nuclei
	Self- or cross-pollination
Antheridia produce sperm	Gametophytes; no antheridia or archegonia
Archegonia produce egg	Ovules produce female gametophytes/gametes
	Pollen: male gametophyte that produces gametes

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Question 2 (continued)

(c) Mechanisms that disperse offspring to new locations (**4 points maximum)**:

Nonvascular Plants (1 point each)	Flowering Plants (1 point each)
Dispersal of spores by wind	Dispersal through seeds
or	Carried by wind, water, or animal
Dispersal of spores in water	Detailed animal description: fur, etc.
	Detailed wind description: winged seeds, etc.
	Protection of seeds/seeds protect young sporophytes
	Fruits used to lure animals

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Question 3

Water is essential to all living things.

(a) **Discuss** THREE properties of water.

(b) **Explain** each of the following in terms of the properties of water. You are not limited to the three properties discussed in part (a):

- the role of water as a medium for the metabolic processes of cells
- the ability of water to moderate temperature within living organisms and in organisms' environments
- the movement of water from the roots to the leaves of plants

(a) Discuss THREE properties of water (**6 points maximum**):

Name of property **and** correct description **(2 points)**. Points **MUST** provide both property and description.

Property	and Description (2 points jointly)
Polarity of water	Polar covalent bonds created by unequal sharing of electrons between O and H **within** the molecule
Specific heat/high heat capacity	Heat absorption without temperature change
High heat of vaporization	Water molecules absorb energy as it changes state/breaking of bonds by absorbing energy
Adhesion	Attraction to other molecules that are polar or have charge
Cohesion	Attraction to other water molecules due to polar nature of water/ surface tension
Three states of matter	Ice–liquid–gas (vapor) Kinetic energy differences Expands at 4°C to become less dense
Repels hydrophobic material	Moves aside nonpolar substances

(b) Explain each of the following in terms of water properties **(6 points maximum; 2 points for each part)**. To earn 10 points, students must get at least 1 application point for each area.

Water's role as a medium for the metabolic processes of cells **(2 points maximum)**:

- Diffusion—allows for movement of materials through an aqueous solution down the concentration gradient
- Osmosis—movement of water across membranes due to water potential differences (down the gradient)
- Solvent—dissociation/ionization of materials
- Buffer—explanation of role water plays in formation of bicarbonate ion

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Question 3 (continued)

Water's ability to moderate temperature within living organisms/environments **(2 points maximum)**:

- Specific heat—moderates climates, maintains stable temperature in cells, constant internal environment
- High heat of vaporization—perspiration cooling, evaporative cooling
- Ice forming and acting as insulator for lakes, keeping water in liquid state

Water from the roots to the leaves of plants **(2 points maximum)**:

- Transpiration—moving water away from leaves due to water potential differences/evaporation through stomata
- Capillary action of water due to adhesion and cohesion
- Root pressure—driven by osmosis/movement of water into roots
- Negative pressure potential—caused by surface tension of water as it is pulled up xylem

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Question 4

Many organisms require a continuing source of oxygen for respiration. **Discuss** important structural and physiological adaptations for oxygen uptake in THREE of the following:

- a paramecium
- a tree
- a fish
- a mammal

Each structural and physiological adaptation earns 1 point. Student must mention at least one structural and one physiological area to earn 10 points. **Only the first three** organisms mentioned earn points.

- **Paramecium (4 points maximum)**:

Structural (1 point each)	Physiological (1 point each)
Membrane surface area/volume small	Utilizes diffusion
Wet habitat	Cytoplasmic streaming
Membrane permeable to oxygen	Ventilation of surface with cilia

- **Tree (4 points maximum)**:

Structural (1 point each)	Physiological (1 point each)
Stomata/guard cells	Stomatal **regulation**
Large wet internal surface area in mesophyll	Surface for gas exchange
Lenticels	Cohesion, transport
Pneumatophores	Pressure flow/source to sink
Root hairs	
Epidermis permeable to oxygen	
	Photosynthesis production of oxygen

- **Fish (4 points maximum)**:

Structural (1 point each)	Physiological (1 point each)
Gills	Countercurrent exchange
Operculum	Operculum movement/gill slit movement
	Ram ventilation (swimming)
Vascularization/gill capillaries	Increase surface area/diffusion
	Blood flow—heart pumping
Hemoglobin	Iron molecules holding oxygen
Lungfish lungs	

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Question 4 (continued)

- **Mammal (4 points maximum)**:

Structural (1 point each)	Physiological (1 point each)
Lungs	Homeostatic adjustments via medulla
Vascularization of alveoli	Capillaries increase surface area/diffusion
Hemoglobin/RBC	Iron molecules holding oxygen
Diaphragm/ventilation (breathing) mechanisms	Ventilation physiology
Four-chambered heart	Separate pulmonary and systemic blood
	Blood flow—heart pumping

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