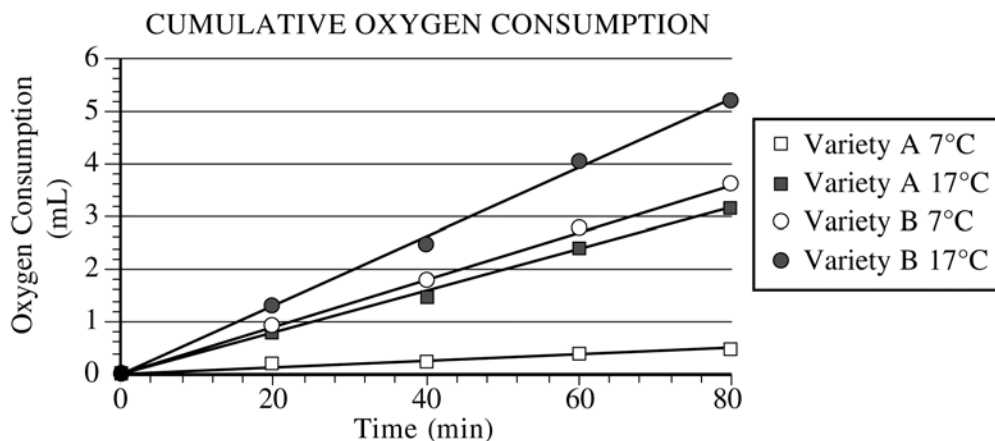


2012 AP[®] BIOLOGY FREE-RESPONSE QUESTIONS

2. An agricultural biologist was evaluating two newly developed varieties of wheat as potential crops. In an experiment, seedlings were germinated on moist paper towels at 20°C for 48 hours. Oxygen consumption of the two-day-old seedlings was measured at different temperatures. The data are shown in the graph below.

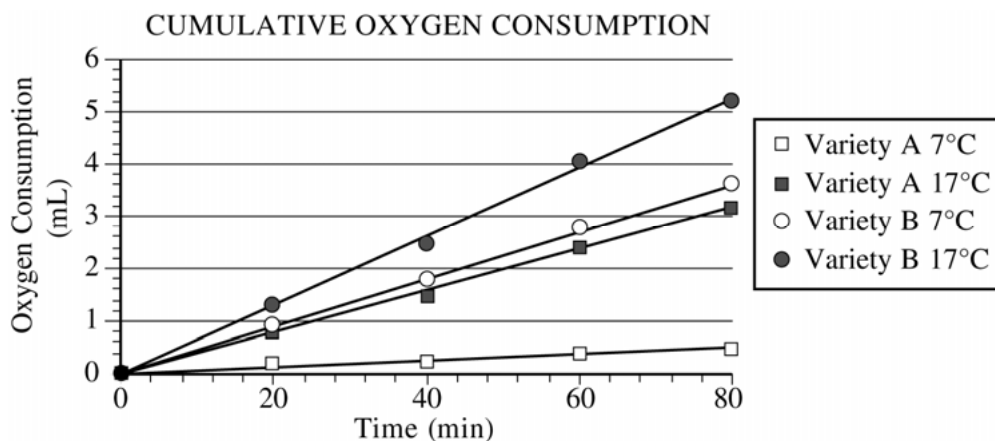


- (a) **Calculate** the rates of oxygen consumption in mL/min for each variety of wheat at 7°C and at 17°C. **Show** your work (including your setup and calculation).
- (b) **Explain** the relationship between metabolism and oxygen consumption. **Discuss** the effect of temperature on metabolism for each variety of seedlings.
- (c) In a second experiment, variety A seedlings at both temperatures were treated with a chemical that prevents NADH from being oxidized to NAD⁺. **Predict** the most likely effect of the chemical on metabolism and oxygen consumption of the treated seedlings. **Explain** your prediction.
3. Information flow in cells can be regulated by various mechanisms.
- (a) **Describe** the role of THREE of the following in the regulation of protein synthesis:
- RNA splicing
 - repressor proteins
 - methylation
 - siRNA
- (b) Information flow can be altered by mutation. **Describe** THREE different types of mutations and their effect on protein synthesis.
- (c) **Identify** TWO environmental factors that increase the mutation rate in an organism, and **discuss** their effect on the genome of the organism.
- (d) Epigenetics is the study of heritable changes in the phenotype caused by mechanisms other than changes in the DNA sequence. **Describe** ONE example of epigenetic inheritance.

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Question 2

An agricultural biologist was evaluating two newly developed varieties of wheat as potential crops. In an experiment, seedlings were germinated on moist paper towels at 20°C for 48 hours. Oxygen consumption of the two-day-old seedlings was measured at different temperatures. The data are shown in the graph below.



- (a) **Calculate** the rates of oxygen consumption in mL/min for each variety of wheat at 7°C and at 17°C. **Show** your work (including your setup and calculation).
(3 points maximum)

- **1 point** for using the rate formula (Dy/Dx)
- **1 point** for using appropriate data to calculate the slope for at least three treatments
- **1 point** for giving answers in decimal format of mL/min

Note: Setup can choose any pair of points for the rise-over-run calculation of rate. The values used in the calculations can be greater or less than those shown in the examples below. Units of mL/min are implied by the question stem and need not be specifically shown.

Variety A at 7°C	$(0.5 - 0 \text{ mL}) / (80 - 0 \text{ min}) = 0.0062 \text{ mL/min}$
Variety A at 17°C	$(3.2 - 0 \text{ mL}) / (80 - 0 \text{ min}) = 0.040 \text{ mL/min}$
Variety B at 7°C	$(3.6 - 0 \text{ mL}) / (80 - 0 \text{ min}) = 0.045 \text{ mL/min}$
Variety B at 17°C	$(5.2 - 0 \text{ mL}) / (80 - 0 \text{ min}) = 0.065 \text{ mL/min}$

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Question 2 (continued)

- (b) **Explain** the relationship between metabolism and oxygen consumption. **Discuss** the effect of temperature on metabolism for each variety of seedlings.
(4 points maximum)

Explanation of relationship (1 point)

- As metabolism increases, oxygen consumption increases.
- OR,**
- As metabolism decreases, oxygen consumption decreases.

Discussion (1 point per bullet; 3 points maximum)

Interpretation of graph

- General statement that increasing temperature increases metabolic rate/oxygen consumption (no specific mention of variety A or B).
- OR,**
- Variety A: rate of metabolism/oxygen consumption increases with an increase in temperature.
- Variety B: rate of metabolism/oxygen consumption increases with an increase in temperature.

Comparison of varieties

- Variety B has a higher metabolism/oxygen consumption than variety A at either temperature.
- Variety B has better metabolism/oxygen consumption at lower temperatures than variety A.

Elaboration of temperature

- Kinetic energy increases with temperature.
- Enzyme reaction rates increase with temperature.
- Effects on electron transport chain (ETC)/system.

- (c) In a second experiment, variety A seedlings at both temperatures were treated with a chemical that prevents NADH from being oxidized to NAD⁺. **Predict** the most likely effect of the chemical on metabolism and oxygen consumption of the treated seedlings. **Explain** your prediction.
(5 points maximum)

Prediction (1 point each; 2 points maximum)

- Metabolism/respiration stops/declines/decreases/slows down.
- Oxygen consumption stops/declines/decreases/slows down.

Explanation (1 point each; 3 points maximum)

- Glycolysis/Krebs cycle/ETC will stop.
- ATP levels will drop/decline/decrease.
- Oxygen cannot accept electrons from ETC.