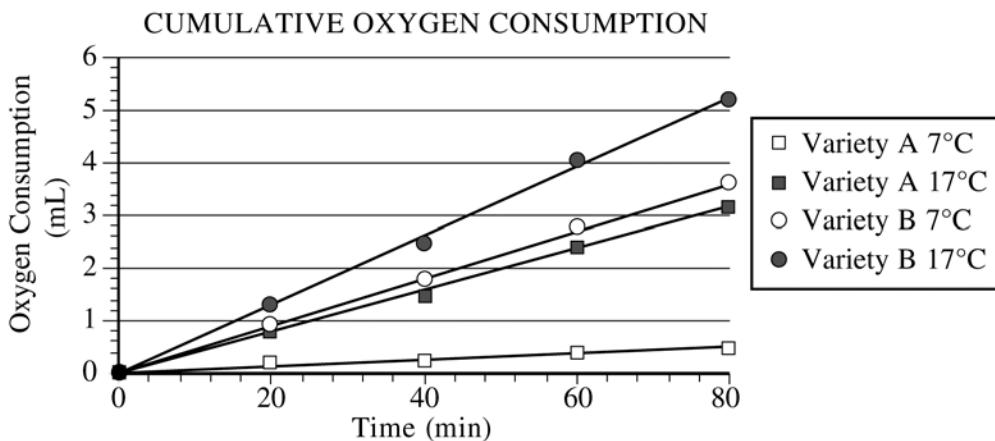


## 2012 AP® BIOLOGY FREE-RESPONSE QUESTIONS

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.

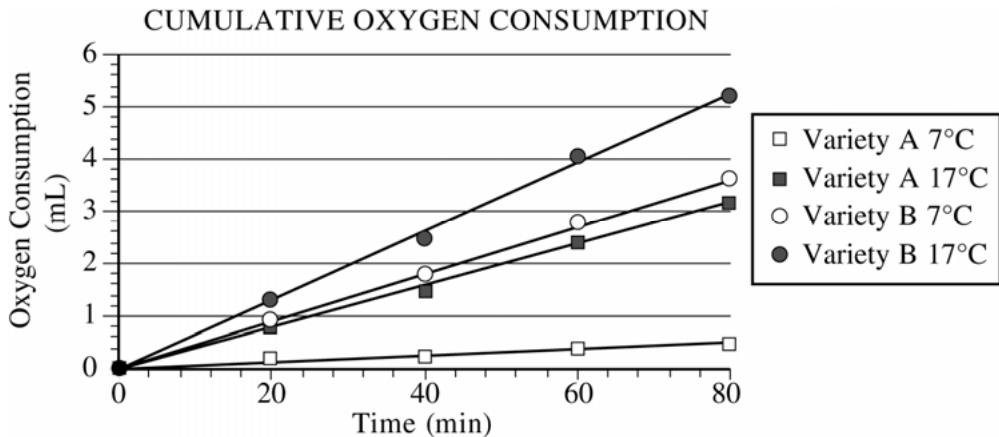


- (a) Calculate the rates of oxygen consumption in mL/min for each variety of wheat at 7°C and at 17°C. Show your work (including your setup and calculation).
- (b) Explain the relationship between metabolism and oxygen consumption. Discuss the effect of temperature on metabolism for each variety of 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<sup>+</sup>. 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<sup>+</sup>. **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/slow down.
- Oxygen consumption stops/declines/decreases/slow 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.