

3. Researchers hypothesize that the plant compound resveratrol improves mitochondrial function. To test this hypothesis, researchers dissolve resveratrol in dimethyl sulfoxide (DMSO). The solution readily passes through cell membranes. They add the resveratrol solution to mammalian muscle cells growing in a nutrient-rich solution (culture medium) that contains glucose. They measure ATP production at several time points after the addition of the resveratrol solution and find an increase in ATP production by the muscle cells.
- (a) **Describe** the primary advantage for a mammalian muscle cell in using aerobic respiration over fermentation.
  - (b) **Identify** an appropriate negative control for this experiment that would allow the researchers to conclude that ATP is produced in response to the resveratrol treatment.
  - (c) **Predict** the effect on short-term ATP production when resveratrol-treated mammalian muscle cells are grown in a culture medium that lacks glucose or other sugars.
  - (d) The researchers find that resveratrol stimulates the production of components of the electron transport chain. The researchers claim that treatment with resveratrol will also increase oxygen consumption by the cells if glucose is not limiting. **Justify** the claim.

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**Write your responses to this question only on the designated pages in the separate Free Response booklet.**

**Question 3: Scientific Investigation****4 points**

Researchers hypothesize that the plant compound resveratrol improves mitochondrial function. To test this hypothesis, researchers dissolve resveratrol in dimethyl sulfoxide (DMSO). The solution readily passes through cell membranes. They add the resveratrol solution to mammalian muscle cells growing in a nutrient-rich solution (culture medium) that contains glucose. They measure ATP production at several time points after the addition of the resveratrol solution and find an increase in ATP production by the muscle cells.

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- (a) **Describe** the primary advantage for a mammalian muscle cell in using aerobic respiration over fermentation. **1 point**

- More ATP (per glucose molecule) is produced by aerobic respiration.

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- (b) **Identify** an appropriate negative control for this experiment that would allow the researchers to conclude that ATP is produced in response to the resveratrol treatment. **1 point**

Accept one of the following:

- The researchers must run the experiment without adding resveratrol.
- The researchers must treat the cells with DMSO alone.

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- (c) **Predict** the effect on short-term ATP production when resveratrol-treated mammalian muscle cells are grown in a culture medium that lacks glucose or other sugars. **1 point**

Accept one of the following:

- No ATP production
- Reduced ATP production

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- (d) The researchers find that resveratrol stimulates the production of components of the electron transport chain. The researchers claim that treatment with resveratrol will also increase oxygen consumption by the cells if glucose is not limiting. **Justify** the claim. **1 point**

- More electrons can be transferred so that more oxygen is required as the final electron acceptor.

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**Total for question 3    4 points**