# Taking Macromolecules to Micro MiniLab Student FRQs

**Cat# M3014**

Version 073126




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This resource provides 3 total FRQs of the following types:

- Question 1: Interpreting and Evaluating Experimental Results (9 pts)
- Question 4: Conceptual Analysis (4 pts)
- Question 6: Analyze Data (4 pts)

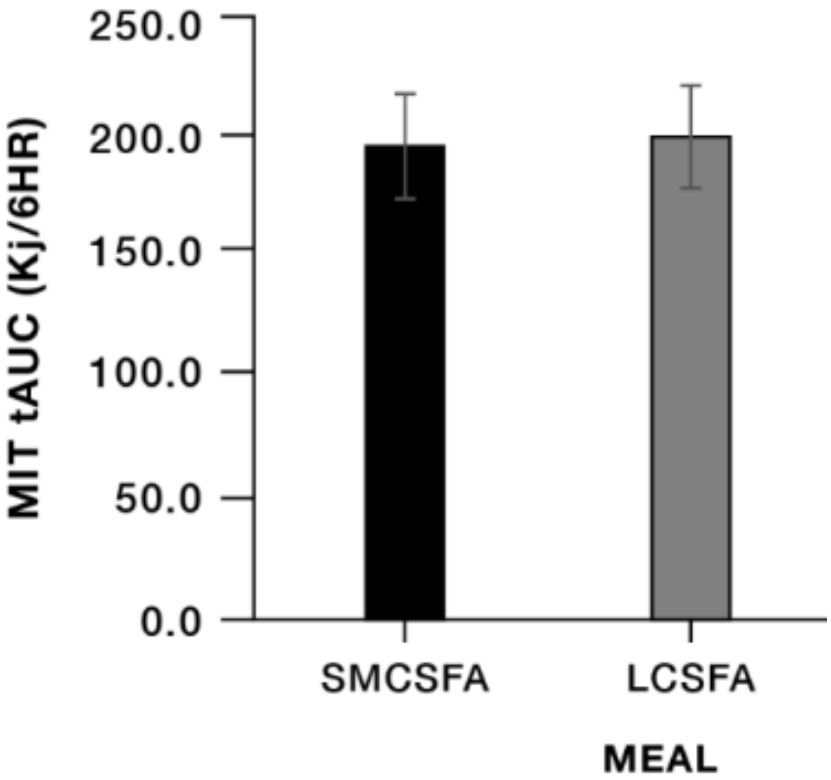
**Q1.** Researchers studied different types of fats to determine how they affect the body differently.

**Part A**

**Describe** the difference in the molecular structure between saturated and unsaturated fats.

Meal-induced thermogenesis (MIT) is the energy the body uses to digest, absorb, and store nutrients. Participants in a study consumed high fat test meals (A and B) on two separate occasions, one week apart. Meal A was high in saturated fats. Meal B was high in unsaturated fats. All other nutrients in the meals were kept consistent. Each meal took place after a 12-hour fast. Researchers took baseline measurements of participants height, weight, body composition, and resting metabolic rate before eating the meals. Measurements of MIT were taken in kilojoules repeatedly every hour for six hours after the participants ate their test meal.

**Figure 1. Effect of high saturated fat meal and unsaturated fat meal on meal-induced thermogenesis (Error bars represent $\pm SE_{\bar{x}}$).**



**Q1. Continued**

**Part B**

i. **Identify** the independent variable in the experiment.

ii. **Justify** the researchers methods of participants completing a 12-hour fast before they ate the test meals.

iii. Based on Figure 1, **describe** the effect of a meal high in saturated fats on MIT compared to a meal high in unsaturated fats.

A different group of researchers tested mice to see if a diet high in saturated or unsaturated fats would change the amount of plaque buildup in their aortas (the main artery of the heart). Mice were fed either a diet high in saturated fat from butter (WD-B) or a diet high in unsaturated fat from corn oil (WD-CO). After 12 weeks a reagent called Sudan IV was used to determine the amount of plaque buildup in the aortic arch and arteries coming off the aorta (Figure 2).

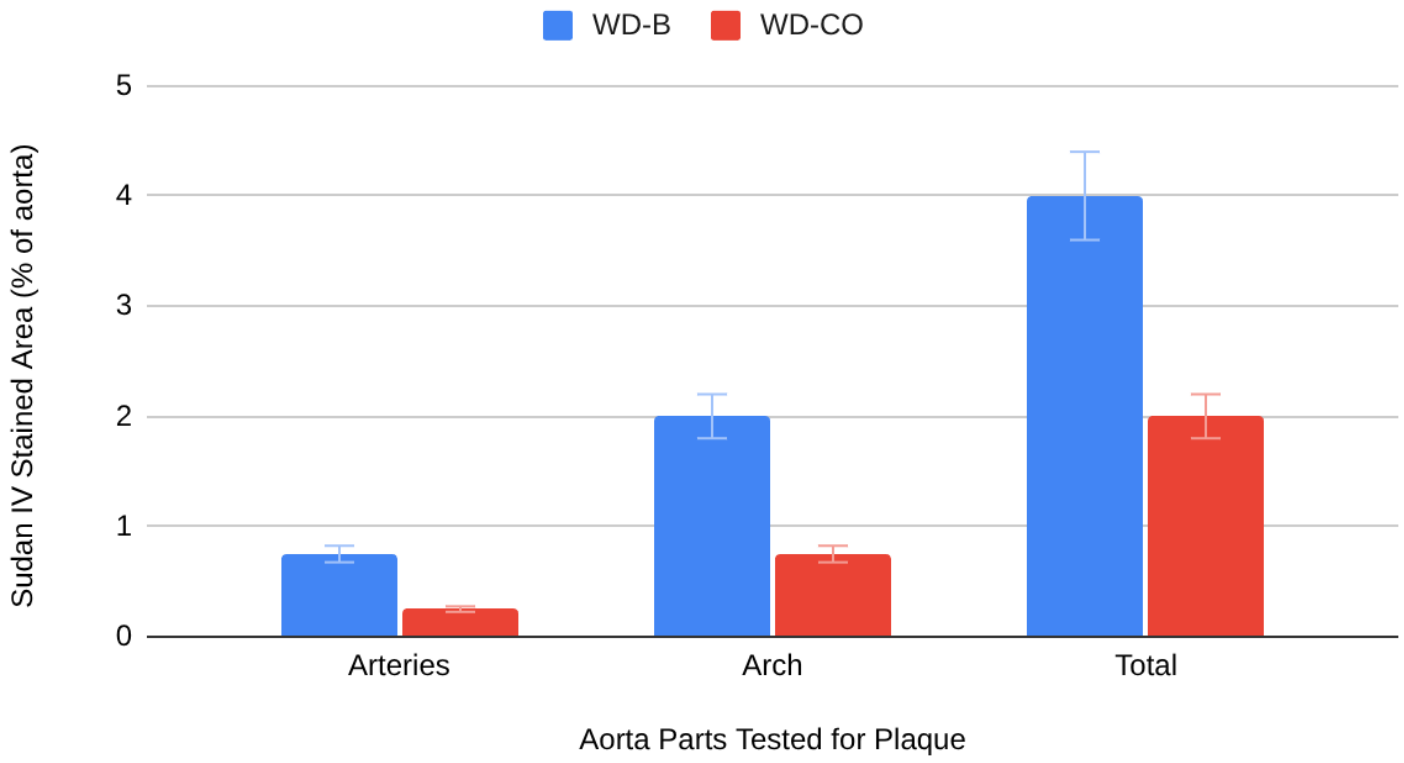



**Figure 2: The effects of a diet high in saturated fats (WD-B) and a diet high in unsaturated fats (WD-CO) on the amount of plaque build up as seen in the Sudan IV stained area of the aorta (Error bars represent $\pm SE_{\bar{x}}$).**

**Q1. Continued**

**Part C**

i. **Identify** the dependent variable of the second experiment with mice.

ii. **Calculate** the difference in the mean % of aorta with plaque buildup total in the WD-B and WD-CO mice.

iii. Based on Figure 2, **evaluate** the researchers claim that unsaturated fats cause smaller amounts of plaque buildup than saturated fats.

**Part D**

As animals get ready to hibernate they store more fat as unsaturated phospholipids than saturated.

i. **Predict** the effect of the increased stores of unsaturated fats on the animal's cell membranes in freezing temperatures.

ii. **Justify** your prediction.

**Q4.** The human body is unable to make nine of the twenty amino acids used to form cellular proteins. These nine essential amino acids must be gained through diet.

**Part A**

**Describe** the structure of an amino acid.

**Part B**

**Explain how** the process of hydrolysis of a protein leads to free amino acids.

**Part C**

In a particular protein a polar amino acid is substituted for a nonpolar amino acid. **Predict** the effects of this disruption on the protein's function.

**Part D**

**Justify** your prediction.

**Q6.** Bacteria are an essential part of wetland communities. The diversity of the bacteria are key to maintaining ecological balance and long-term effectiveness of the wetland. Researchers use DNA sequencing to determine the relative abundance present in different wetland communities to see which is the most resilient.

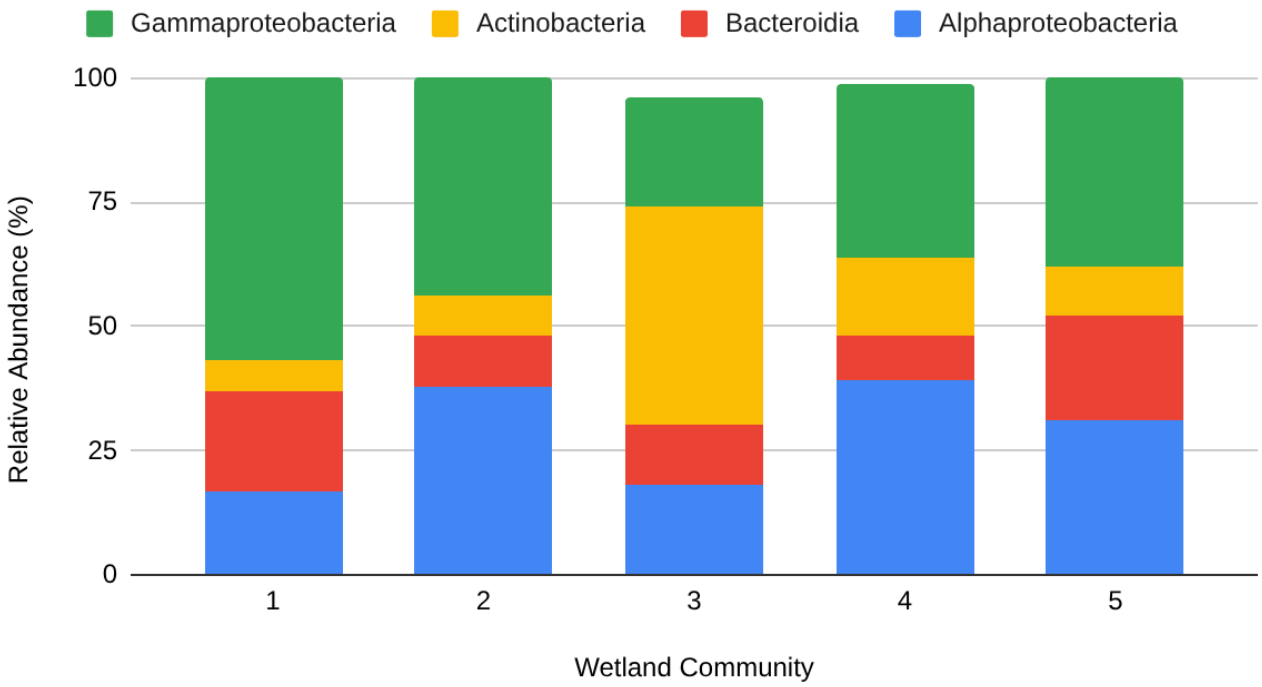



**Figure 1: A comparison of the relative abundance (%) of different bacteria in wetland communities**

### Part A

Based on Figure 1, **identify** the group of bacteria that has the most consistent relative abundance across the five wetland communities.

### Part B

Based on Figure 1, **identify** the relative abundance (%) of Gammaproteobacteria in Wetland Community 4.

**Q6. Continued**

**Part C**

Researchers hypothesize that Community 5 is more diverse than Community 1. Use the following data and Simpson's Diversity Index to **evaluate** the researchers' hypothesis.

| Wetland Community | Alphaproteobacteria | Bacteroidia | Actinobacteria | Gammaproteobacteria |
|---|---|---|---|---|
| 1 | 17 | 20 | 6 | 57 |
| 5 | 31 | 21 | 10 | 38 |

**Part D**

In order for researchers to identify the species of bacteria using DNA sequencing, they first needed to amplify a specific portion of each bacterial genome using polymerase chain reaction (PCR). During the final step of PCR, new complementary DNA strands are built after the double stranded DNA is separated. **Explain how** researchers are able to add all four nucleotides in different orders to the sample, but the correct sequence will still always be built from the separated DNA strands.

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