

# Climate Solutions

## Workshop # 1      Proxy Measures

Names in the Group: \_\_\_\_\_

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Thoroughly discuss each of these questions in your group. Then write a clear response to each of them.

1. What is meant by the phrase *proxy measures*?
2. What is meant by the phrase *isotope discrimination*, or *isotopic discrimination*?
3. Define what is meant by  $\delta^{13}\text{C}$ . Explain in words and write a formula for it.
4. For what is a measure of  $\delta^{13}\text{C}$  a proxy? Explain.
5. Sediments of organisms are found to have a high  $\delta^{13}\text{C}$  ratio. What does this suggest about conditions when the organisms were living? Explain your reasoning carefully and clearly.

5. Limestone (carbonate rock) from two different locations has two different  $\delta^{13}\text{C}$  values. From the first location  $\delta^{13}\text{C}$  is relatively small, while from the second location  $\delta^{13}\text{C}$  is relatively large? What conclusions might you draw about the differences between the limestone rocks formed at each location? Explain your reasoning carefully and clearly.

6. Based upon your responses to questions 4 and 5, fill in the following table with the conclusions you might draw about the conditions when the organisms, or the rocks, were formed:

	$\delta^{13}\text{C}$ high	$\delta^{13}\text{C}$ low
<b>Organic Sediments</b>		
<b>Carbonate Rock</b>		

7. Of what is pH a measure?

8. How would you characterize a substance of pH 3?

9. How would you characterize a substance of pH 10?

10. Define what is meant by  $\delta^{11}\text{B}$ . Explain in words and write a formula for it.

11. For what is a measure of  $\delta^{11}\text{B}$  a direct proxy? Explain.
  
12. For what is a measure of  $\delta^{11}\text{B}$  an indirect proxy? Explain.
  
13. Define what is meant by  $\delta^{18}\text{O}$ . Explain in words and write a formula for it.
  
14. For what is a measure of  $\delta^{18}\text{O}$  a proxy? Explain.
  
15. Shell of marine organisms from a sample taken on the Olympic peninsula have a relatively low  $\delta^{18}\text{O}$ . What does this tell you about the conditions under which the organisms were formed? Explain.

16. Define what is meant by  $\delta D$ . Explain in words and write a formula for it.

17. For what is a measure of  $\delta D$  a proxy? Explain.

18. A section of an ice core taken from Greenland has a relatively low value of  $\delta D$ . What does this tell you about the conditions when that ice was formed? Explain.

19. Summarize a portion of your work above in the following table:

	<b>A proxy for</b>
$\delta^{13}\text{C}$	
$\delta^{11}\text{B}$	
$\delta^{18}\text{O}$	
$\delta\text{D}$	