

## SECTION

## 3

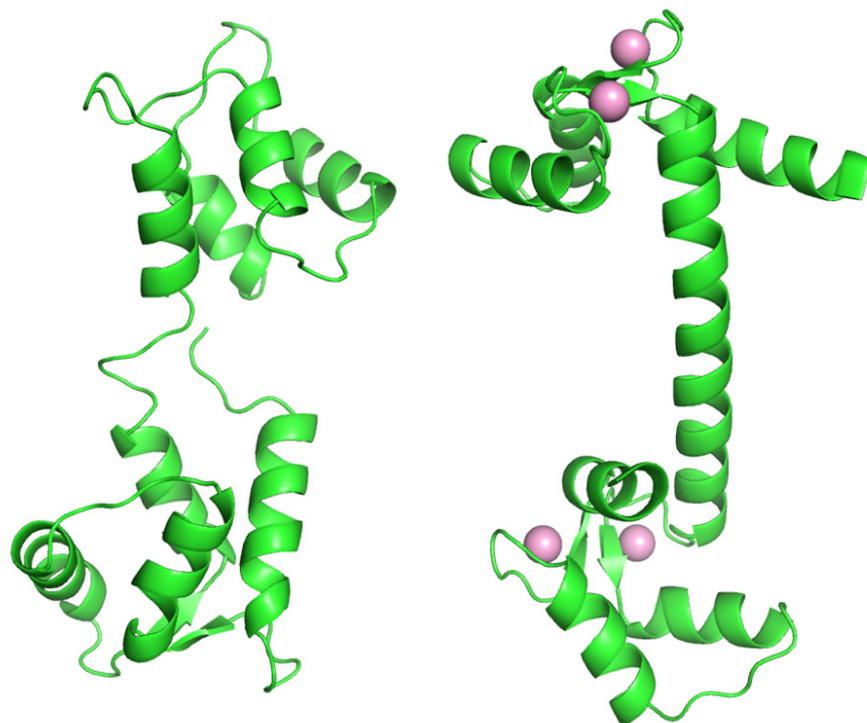
Structure of the Protein  $\alpha$  Helix

## POST-ACTIVITY

## SKILL EXERCISES

Calmodulin is a small protein that detects calcium ions in the cell and transfers that information to other regulatory proteins. The 3-dimensional structure of calmodulin has been determined in both the presence and absence of calcium ions. In the images below and the PyMOL session files provided, the calcium ions are pink and the protein structure is shown in green. Note that the primary sequence of calmodulin is the same in the presence and absence of calcium.

1. Carefully investigate the two structures of calmodulin using the PyMOL session files posted on Canvas.
  - a. In a few sentences, discuss similarities and differences in **secondary** structure.
  - b. In a few sentences, discuss similarities and differences in **tertiary** structure.



2. Calcium ions are non-covalently bound to calmodulin using aspartate and glutamate residues. Using the PyMOL session files, locate two specific glutamate or aspartate residues in the **calcium-free** calmodulin structure. Describe where two calcium-binding residues you identified are located in the calcium-free structure using the terminology of secondary and tertiary structure, and circle their approximate location in the image above. Hint: the residue numbers are the same in the two structures.
3. What are the glutamate or aspartate residues that you identified in question 2 interacting with in the calcium-free calmodulin structure? Describe the non-covalent interactions at work.
4. In modern biochemistry, we often invoke a fundamental assumption that primary sequence completely determines secondary and tertiary structure. Yet, there are cases where a single primary structure can form more than one stable tertiary structure. Based on your analysis of calmodulin, briefly discuss the factors besides primary structure that determine the tertiary structure of calmodulin.