Introduction & Purpose: Structural geology is the study of how geologic rock units are initially arranged and later deformed. Changing spatial relations between geologic units and the stress and strain that occur during deformation events are key aspects in understanding geologic structures. The purpose of this lab is to both learn and apply the concepts of structural geology to reading and interpreting geologic structures, including tilted beds, folds, and faults. The terms and concepts of geologic structures, the application of structural geology to mountain building events, and the techniques used to interpret geologic structures will be presented and discussed. The three types of graphic representations of geologic structures: 1) geologic maps, 2) geologic cross sections, and 3) block diagrams will also be highlighted and discussed.

Part I. Pre-Lab - Knowing and Understanding Structural Terms and Symbols:

A. Review of Rules for Interpreting Geologic Structures

There is a set of rules of structural geology used for interpreting geologic structures found in Figure 10.11 in your lab manual. Carefully study and make use of these rules for completing Part II. The most important rules are listed below:

1) Strike of beds is always parallel to the direction of the contacts.
2) Rock layers dip towards the youngest exposed rock layers.
3) Oldest rocks exposed in the center of eroded anticlines and domes.
4) Youngest rocks exposed in the center of eroded synclines and basins.
5) Horizontal folds form parallel sets of belt-like outcrop patterns.
6) Plunging anticlines form “V” of “U” shaped, belt-like outcrop patterns.
   ✓ Anticline fold plunges toward closed end of “V” or “U” pattern.
7) Plunging synclines form “V” of “U” shaped, belt-like outcrop patterns.
   ✓ Syncline fold plunges toward open end of “U” pattern.
8) Steeper the dip of the layer, the more narrow the width of its outcrop.
9) Hanging wall moves up relative to foot wall in reverse and thrust faults.
10) Hanging wall moves down relative to foot wall in normal faults.
11) Slickenside grooves that are oriented horizontal in fault scarp indicate strike-slip offset.
12) Slickenside grooves that are oriented vertical in fault scarp indicate dip-slip offset.

Part II - In-Lab: Drawing and Interpreting Geologic Structures in Block Diagrams

Introduction: Three-dimensional geologic block diagrams are scaled-down, abstract, simple representations, or models of Earth’s crustal rock structures, which include 1) formations, 2) unconformities, 3) faults, 4) folds, and 5) topography. Block diagrams are a 3-dimensional composite of both, a geologic map (horizontal map-view) and geologic cross-sections (vertical side-views). The key to successfully completing the block diagrams lies in visualizing the 2-D representations as 3-D structure.
A. STRIKE AND DIP BED AND BLOCK EXERCISES

1. Measure the strike and dip of the two planar objects the instructor has set up in the class:
   
   a) Planar Object #X - Strike = _____  Dip = _____
   
   b) Planar Object #Z - Strike = _____  Dip = _____

2. a) Complete the block (below) using the strike and dip shown on block's top.  
   b) Number all the beds.  
   c) Estimate the dip amount and write it next to the strike and dip symbol.  
   d) State the strike and dip in words here: ____________________

   ![Block Diagram](image1)

3. a) Complete the block below using a 60° dip amount.  Note that the dip (tilt) direction must be determined from the age of the layers.  
   b) Place a strike and dip symbol on the top of the block.  
   Estimate the strike and dip of the beds.  ____________________

   ![Block Diagram](image2)

B. FAULT BLOCK EXERCISES

1. a) In map view (top of block), put strike and dip symbols on the beds and a fault dip symbol on fault.  
   b) Also put appropriate displacement arrows on the fault in the frontal cross-section.  
   What type of fault is shown below? ____________________

   ![Fault Block Diagram](image3)
2. a) Put appropriate fault displacement arrows, fault dip symbol, and strike and dip of beds symbols in both the map view and cross-section. **What type of fault** is shown below if the slickensides are *parallel to the dip*? ___________________

![Map View and Cross-Section with Fault Symbols](image1)

3. a) Put appropriate fault displacement arrows, fault dip symbol, and strike and dip of beds symbols in both the map view and cross-section. **What kind of fault** is shown below if slickensides are *parallel to the dip*? _______________

![Map View and Cross-Section with Fault Symbols](image2)

4. a) Draw the appropriate symbols for the fault in both the map view and cross-section. b) Draw strike and dip symbols for the beds. **What type of fault** is shown below if the slickensides are *oriented horizontally*? _______________

 Estimate the strike and dip of the fault: ________________ Estimate dip of beds. _____

![Map View and Cross-Section with Fault Symbols](image3)
5. What type of fault is shown below if the slickensides are oriented horizontally? __________
   Estimate the strike and dip of the fault: ______________ Estimate the dip of beds. _____

C. FOLD BLOCK EXERCISES
1. a) Complete the block (below). b) Number the beds from oldest to youngest (1 being oldest).
   c) Indicate the axial plane and fold axis with appropriate symbols in both the map view and cross section. What is the name of this structure? _______________

2. a) Complete the block diagram (below). b) Place strike and dip symbols on the map view (top of block) to indicate the structure. c) Label the axial planes and fold axes with the appropriate symbols. What is the name of this structure? ____________________________
3. **a)** Complete the block (below). Dip amount is arbitrary, but dip direction is not. **b)** Number the beds from oldest to youngest (1 being oldest). **c)** Indicate the axial plane and fold axis with appropriate symbols in the map view and cross-section of the block. **d)** Place strike and dip symbols on top. **What is the name of this structure?**

4. **a)** Complete the block (below). **b)** Number the beds from oldest to youngest (1 being oldest). **c)** Indicate axial plane and fold axis with appropriate symbols in the map view and cross-section. **What is the dip angle? _____**. **What is the name of this structure? __________**

5. **a)** Complete the block (below). **b)** Number the beds from oldest to youngest (1 being oldest). **c)** Indicate the axial plane and fold axis with appropriate symbols in the map view and cross-section face of the block. **d)** Draw strike and symbols on the map view. **What is the fold plunge angle? _____**. **What is the name of this structure? __________**
6. a) Complete the block (below). b) Number the beds from oldest to youngest (1 being oldest). c) Indicate the axial plane and fold axis with appropriate symbols in the map view and cross-section face of the block. d) Draw strike and symbols on the map view. Note bed width for #2. 
What is the bed dip angle? _____.
What is the name of this structure? ______________

7. a) Complete the block (below). b) Number the beds from oldest to youngest (1 being oldest). c) Indicate the axial plane and fold axis with appropriate symbols in the map view and cross-section face of the block. d) Draw strike and symbols on the map view.
What is the bed dip angle? _____.
What is the name of this structure? ______________

Part III – Structural Geology II Laboratory Reflection
Directions: Write a 120 word minimum reflection of the lab activity, explaining its purpose, the methods used, the results obtained, and a brief personal reflection of what you enjoyed and learned about doing this lab (3 points possible). Answer the following 3-point question reflection set on a separate sheet of paper:

1) What was the purpose of this lab? What did you actually discover and learn during this lab?

2) What did you enjoy most about this lab? Also, what was challenging or thought-provoking?

3) What are your constructive comments about the design and execution of this lab? What’s good? What’s bad? Offer suggestions for making the lab better.