Name: _____

Lab 10: Glacial Features and Interpretation of Imagery

Objectives:

- To learn to recognize, analyze, and interpret glacial landforms, and to learn to map these landforms using aerial photographs and topographic maps.
- To learn to quickly extract elevation profiles from Google Earth for preliminary analyses.

Part 1: Identifying landforms produced by alpine glaciation

Use the **McHenry's Peak** 1:24,000 topographic map to answer the following questions:

1. What glacial feature is represented by Windy Gulch (about 7 miles west of Estes Park)? How did it form?

2. a) Through the center of the park, the Continental Divide runs NW to SE. Which side of the divide shows more evidence of current glacial activity?

   b) Was this also true in the past? What is your evidence?

   c) Why does this phenomenon occur?

3. **Locate one good example** of each of the glacial features mentioned below, and clearly indicate its name or location. **Make a quick sketch** of the feature as it appears on the map as well:

   a) Cirque:

   b) Arete:

   c) Col:

   d) Horn:

   e) Tarn:

   f) Paternoster lakes:

g) Hanging valley:

Questions using the **Mount Rainier quadrangles (you will have to alternate turning these off and on to see the summit clearly)**:

4. Notice the asymmetry in the size and location of glaciers around the summit. Why would this occur?

5. a) Look carefully at the trough in which the White River flows. Does it appear that the Emmons glacier once extended further down the valley than presently?

   b) Give two pieces of topographic evidence for your answer to part a.

6. a) What are the channel patterns of the White River, the West Fork White River, and the Carbon River?

   b) List two reasons for this channel pattern to occur.

Part 2: Identifying landforms produced by continental glaciation

Questions using the **Jackson, Michigan** 1:62,500 topographic map:

1. What is the name for the lakes which occur in the numerous depressions on this map?

2. a) What glacial feature is represented by Blue Ridge?

   b) Explain how this feature formed.

Questions using the **Ayer, Mass** 1:25,000 topographic map:

1. a) Oak Hill is composed of bedrock, but the smaller hills to the north are not. What are these features?

   b) What are they composed of?

2. a) What direction did the ice move in this area?

   b) What is your evidence?

Part 3: Mapping glacial topography in the Cache la Poudre River

During the height of the Pleistocene, alpine glaciers mantled most of the western mountain ranges north of 35 degrees latitude. Pale remnants of the Pleistocene glaciers remain today, but the effect of the glacial epoch is amply recorded in many terrains.

The goal of this problem is to familiarize you with a number of glacier-related landforms near CSU. Using the **imagery in Google Earth and provided aerial photographs**, consider the glacial history of the Cache la Poudre River. NOTE: you can adjust the transparency of an overlay (like the topo maps) in Google Earth by clicking the transparency button under "Places" ().**DO NOT SCRATCH OR MANGLE THE AERIAL PHOTOGRAPHS IN ANY WAY, AND DO NOT REMOVE THE PROTECTIVE PLASTIC COVERS!**

1. By examining the aerial photographs and Google Earth, locate and color-code each of the following landforms on the attached photocopies of the Kinikinik, CO 7.5 minute topographic quadrangle. Be sure to include a color-coded key with your map (the colors below are just suggested colors).

Limit of glaciation = black line	Lateral moraine = brown
Floor of main glacial trough = dark blue	Terminal moraine = yellow
Floor of hanging valley = light blue	Alluvial fans = green
Bedrock = orange	River terraces = red

2. Select 2 locations that you would examine during a field visit, mark each with a red dot, and number them 1 and 2. These should be areas where you are uncertain of the origin of a specific feature.

3. Based on the aerial photos and the topographic map, describe your preliminary ideas about the origins of each feature chosen in question 2. What **specific** characteristics do you expect to find in the field if your assessments are correct (morphology, deposit characteristics, etc.)? Use the space below.

Location #1

Location #2

4. a) Measure and compare the sinuosity of the Cache la Poudre River upstream and downstream of the "X" marked on the photocopied map.

Upstream _____

Downstream _____

b) Measure the slope (**in feet per mile**) of the Cache la Poudre River upstream and downstream of the X (measure from the X to the edge of the map).

Upstream _____

Downstream _____

c) How does slope affect the sinuosity of the river in this area?

d) Considering your answer to c, describe how glacial activity has affected the reach of the Poudre River shown on the photocopied map. Be sure to consider rates of lateral erosion and incision, as well as floodplain attenuation.

e) What factors do you think controlled the extent of glaciation in the Cache la Poudre River valley? (ie, why did the glaciers stop where they did?)

Part 4: Analyzing the Cache la Poudre Valley Morphology (Kinikinik Quad)

1. Find transects A-A′ and B-B′ (double click on the placemarks to zoom to the location). Use Google Earth to create a topographic profile using the steps below:
    1. Using the path tool, create a path between A and A' (or B and B'). Make sure you place enough nodes (individual clicks defining the profile) to get a detailed profile. Alternatively, simply hold the left mouse button down to create as many nodes as possible along the profile.
    2. In the "New Path" dialog box, name the path accordingly (e.g., A-A') and click OK
    3. Under the "Places" menu on the left, select your profile, right click, and select "Save Place As". Save it as a .kmz file with an appropriate name.
    4. Go to http://gpsvisualizer.com/convert_input
    5. Select "Plain Text" as the Output format.
    6. Click "Choose File" and navigate to your saved .kmz file. Select it and hit Open
    7. Make sure the Plain text delimiter is set to "tab" and the Plain text output units is set to "Metric"
    8. Under "Add DEM elevation data" use the dropdown box to select "From best available source"
    9. Near the bottom of the options box, click on "[+] show advanced options"
    10. Scroll to the very botom of the "advanced options" box
    11. Under "Output UTM coordinates", use the dropdown box to select "Yes"
    12. Click the "Convert" button
    13. On the next screen, click the link near the top (third line down from the header bar) to download your .txt file.
    14. Open the excel file for this lab
    15. In excel, go to open, then navigate to the text file you just downloaded.
    16. Be sure the dropdown box in the lower right of the "Open" dialog box is set to "Text Files" or "All Files"
    17. Select and open the .txt file you just downloaded.
    18. In the Text Import Wizard, Click "Next", then "Finish"
    19. Delete columns A, B, C, D, H, I, J, K, and L
    20. Copy the remaining columns to the excel spreadsheet provided for this lab. This spreadsheet will automatically fill out the "horizontal distance" column for the data. If your profile is too long, simply drag down the equation in the "horizontal distance" column to fit your data.

21. Plot your profile using a scatter plot with lines connecting the dots
22. Be sure to include a descriptive title and axes labels to your plot
23. Repeat for the second profile

24. Use the cross-sections to measure the cross-sectional area eroded by fluvial processes and the cross-sectional area eroded by glacial processes. To do this, calculate the area by parceling the profile into rectangles. Feel free to do this by hand. Or, use excel. The formula in excel could look something like this (starting on the 2nd cell down in a column: (area of individual rectangle) =((maximum elevation of profile) - (elevation at a point)) * (distance between this point and the one before it). The sum of the areas of the rectangles would then be the total cross-sectional area.

25. a) According to the areas calculated above, which process -- glacial or fluvial -- appears to have been the more effective erosive agent in the Cache la Poudre River?

    b) What is the ratio of the amount of glacial erosion to the amount of fluvial erosion?

26. Discuss the assumptions involved in this method of calculation and whether they appear valid here.

27. Briefly describe and compare the morphologic processes that were involved in creating the two distinct morphologies represented by your cross sections.