Some of the samples used in Mineralogy Lab are museum specimens. Please do not destroy them. You can do just about anything you want to the grungy ones, but be nice to the pretty specimens as they are irreplaceable.

Name_______________________________

MINERALOGY LABORATORY

Introduction to Polarized Light Microscopy and Examination of Amphiboles, Micas, Pyroxenes, and Olivines

The mineralogy text cited in this lab is *Mineralogy* (1998), by Dexter Perkins.

1. Box of Rocks

There are four trays, each containing minerals of the different groups: amphibole, mica, pyroxene, and olivine. While at each tray, examine each mineral and record its physical properties, chemical composition, habit, etc. in your lab notebook (be sure to leave some space in your lab notebook to record optical properties later). **Know these for the quiz next week.**

A) What chemical similarities/differences do the minerals of the group have?

B) What physical similarities/differences do the minerals of the group have?

C) Why are there several varieties of minerals in each group? (e.g., What are the differences between the different members of the group?)

2. Observing Optical Properties

For this exercise you will need to be at a microscope. **The rules of microscope use are as follows**:

Always ask questions (if necessary) before attempting to use the microscope
Be very careful with the thin sections- they are very fragile and expensive
Never move a microscope without permission
Never change magnification by grasping the objectives. Always turn the assembly by the top
Always turn off the microscope and replace the cover when finished

The following is a simple guide to operating the microscope.

•remove cover and fully turn on the light source (on bottom of microscope)
•place thin section on the stage, directly over the opening
•put the objective lens onto the lowest power (4X magnification)
•make sure substage is in its highest position and make sure the conoscopic lens is NOT inserted
•adjust diaphragm so that light is not too intense or insufficient
•insert the upper polarizer (a.k.a. cross the polars or XP)
•adjust the width of the oculars so that only one circle is seen when looking into the microscope
•use the focus adjustment to bring the thin section into focus
•remove the upper polarizer
•rotate the stage
•start observations
•insert and remove upper polarizer to toggle between plane and cross-polarized light

3. Define the following in terms of optical microscopy and light rays. Also, state if the property is observed in PP or XP light. Record this info below AND in your lab notebook.

pleochroism-

interference colors-

birefringence-

refractive index-

plane polarized light-

cross-polarized light-

4. Answer the following questions using the thin sections provided. For next week's quiz, be able to identify (in thin section) the minerals discussed below.

#K1 (sillimanite gneiss)

1) While in plane polars (PP) rotate the stage and describe what you see. The description should include how many different minerals are there (don't worry about identifying them just yet) and what do they look like in plane polars. Pay particular attention to relief, pleochroism, crystal habit, and cleavage. Then insert the upper polarizer (XP), rotate the stage and describe what you see. Now how many different minerals can be seen? Are there more or less colors (called interference colors in XP) visible in XP than in PP?
Toggle back-and-forth between PP and XP to see the differences in the view.

Plane polars
(PP)

crossed polars
(PP)

2) This section contains some garnet. It is isotropic (transmits light equally in all directions), lacks cleavage, and has very high relief (very pronounced crystal edges). Garnet grains tend to be equant (roundish, not elongate, etc.). Locate this mineral in the thin section. Then, put in XP and observe the extinction (always observed in XP) of garnet. How does it differ from the other minerals in the section? Make a sketch (XP and PP) of garnet in circles provided below.

Plane polars
(PP)

crossed polars
(PP)

3) Consider all of the other minerals in the thin section. Are they isotropic or anisotropic? Look at an isotropic mineral grain. Rotate the stage. How often (in degrees) does an anisotropic mineral go extinct?

4) This section also contains sillimanite. It has high relief and is often needle-like. It sometimes can be seen as square grains. Why? (Explain why it has two different appearances.) Is sillimanite isotropic or anisotropic? Make a couple of sketches of sillimanite in the space below.

Plane polars
(PP)

crossed polars
(PP)

#2 (Muscovite-Biotite Granite)

1) This section contains both muscovite and biotite. Both of these have bird's eye extinction and high order interference colors (i.e. colors seen in XP). Biotite is brown to yellow or red (PP) and pleochroic with one excellent cleavage. Muscovite is colorless to pale green (PP) with one excellent cleavage. Which one exhibits higher order interference colors? Describe, in your own words, what bird's eye extinction looks like under the microscope. Make a couple sketches in the space below.

Plane polars
(PP)

crossed polars
(PP)

<u>#W28 Hornblende Gabbro</u>

This section contains green, pleochroic hornblende, brown biotite flakes (with lack of bird's eye extinction), and orthopyroxene with low birefringence and very high relief. The section also contains an abundance of an opaque mineral and lots of zebra-striped plagioclase feldspar (we'll examine this in more detail next week).

The hornblende appears similar to biotite except that it has **two** cleavages at 60 and 120, a larger extinction angle, and does not have the distinctive bird's eye extinction the biotite almost always exhibits. What does *extinction angle* mean? What are the maximum interference colors (include color and order) seen in hornblende? Make a couple of sketches in the space below.

Plane polars
(PP)

crossed polars
(PP)

#30 (olivine gabbro)

1) This section is highlighted by clinopyroxene, denoted by its beautiful blue/purple interference colors and well-developed cleavage. Olivine is also present. It has slightly higher order interference colors than clinopyroxene, lacks cleavage, and is commonly altered along its fractures. What are the maximum order interference colors for both olivine and clinopyroxene? Compare and contrast their birefringence. (*Hint:* consult text or Michel-Levy chart)? Make a sketch of a thin-section view in the space below.

Plane polars
(PP)

crossed polars
(PP)

2) Find the opaque mineral that is also present. To do this, find a crystal that appears extinct (black) in both PP and XP. To identify this mineral, it is necessary to use reflected light. Use reflected light to see if it reflects silver or yellow. If it is silver, the mineral is an oxide, either magnetite or ilmenite. If it is yellow, it is a sulfide, either pyrite or pyrrhotite. Which one is present in this section?