The purpose of this lab is to introduce you to the three major types of rocks. You should come away from this lab with an understanding of the techniques used to distinguish the major rock types, and should be able to identify a hand sample when it is presented to you.

All rocks are composed of minerals. Minerals are naturally occurring, solid, inorganic substances with specific chemical compositions. Some common examples are: quartz, calcite, feldspar, and mica, just to name a few.

As mentioned above, there are three major categories of rocks. They are:

1. **Igneous rocks.** These are formed by crystallization directly from molten material. This molten material is called magma when it is below the surface, and lava once it reaches the surface. As the molten rock cools, the atoms within it begin to combine with one another, forming mineral crystals. As cooling continues, the crystals butt up against one another, eventually interlocking and forming a rock made up of many mineral crystals. Igneous rocks can be further categorized by their composition and texture. Igneous rocks with a high percentage of dark, iron and magnesium-rich minerals are said to be “mafic” in composition. Rocks with a relatively high percentage of lightly colored aluminum and silica-rich minerals are said to be “felsic” in composition. The texture of an igneous rock, shown by the size of the crystals in it, is dependent upon the speed at which it cools. The more slowly an igneous rock forms, the larger the crystals. We say the rock has a coarse crystalline texture. The more quickly the rock forms from the melt, the smaller the crystals. These types of igneous rocks are described as having a fine crystalline texture.

2. **Sedimentary rocks.** These are formed in one of two ways. One way is from the erosion, subsequent deposition, and lithification of pre-existing rocks. Sedimentary rocks formed by this process are called “clastic” sedimentary rocks. They are composed of grains ranging in size from very coarse-grained cobbles and pebbles to extremely fine-grained clay particles. Common clastic sedimentary rocks are sandstone, mudstone, breccia, and siltstone. The other way to form sedimentary rocks is by precipitation of minerals from seawater. This may be accomplished by evaporation (often yielding halite [=rock salt]) or through the action of organisms in the water (limestone). We will more closely study sedimentary rocks and the processes associated with them in LAB 2.

3. **Metamorphic rocks.** Under conditions of intense heat and pressure, pre-existing rock can be physically and chemically altered, transforming (“metamorphosing”) into an entirely new type of rock. These are called metamorphic rocks. They have not been re-melted, but the conditions get harsh enough to break down the bonds of many of the minerals making up the rock. When heat and pressure finally subside, entirely new minerals are often left behind, such as garnet. Often, the high pressures will “squish” the rock, resulting in a fabric of parallel arrangements or segregation of crystals, a physical feature called foliation. They are usually denser than their counterparts from being so strongly compacted. Common metamorphic rocks include gneiss (from granite), marble (from limestone), schist (from muddy sediments), and slate (from shale).
An interesting feature about these three rock types is that any one of them can undergo processes that turn them into either of the others, or new versions of the same type. This inter-relationship is called the **rock cycle**, first proposed by James Hutton almost 200 years ago. For example, suppose a particle of quartz forms deep in the earth as part of a large underground mass of granite. Over millions of years, the Earth’s crust is uplifted, the overlying layers of rock erode away, and our little quartz crystal is exposed to the air. A pounding rainstorm knocks the quartz particle off the rock, it rolls down a small stream, and is buried with millions of other rock fragments. After years of burial, dissolved minerals carried in groundwater cements the rock fragments together. Our quartz crystal is now part of a sedimentary rock. Later, the sedimentary rock with the quartz crystal is shoved deep under the surface by tectonic activity. As the rock is shoved deeper, heat and pressure increase greatly. Eventually the sedimentary rock is altered, with the minerals within it being physically and chemically changed, resulting in a metamorphic rock. If the metamorphic rock continues to be heated, the rock may melt entirely and the atoms making up our one-time quartz crystal are released and the process may start all over again. This is just one example of the many different combinations and inter-relationships found in the rock cycle.
Exercises

Examine rock samples 1-10. Based upon the information in this handout, examples given by your TA, and your own senses, determine if each sample is an igneous, metamorphic, or sedimentary rock.

1. 6.

2. 7.

3. 8.

4. 9.

5. 10.

Of the igneous rocks you have identified, which ones are mafic in composition?

Which igneous rock specimens are felsic in composition?

Which igneous rocks formed at the surface?

Which sample(s) formed at depth?

Would you expect to find fossils in specimens 11-13? Why or why not?

11.

12.

13.