Name: _____

Lab day: Tuesday Wednesday Thursday (circle day)

ENVG/SC 10110L-20110L Planet Earth Laboratory

Laboratory #4: Igneous Rocks

Readings: http://www.nd.edu/~cneal/PhysicalGeo/Lab-Igneous/index.html. Total: 92 points.

Introduction: Igneous rocks are defined based on their texture (crystal size, shape, arrangement), and mineralogy. Igneous rocks are formed by the cooling and crystallization of magma within or at the earth's surface. Igneous rocks formed at the earth's surface will be made up of very tiny crystals, or may even be glassy; these are *extrusive* igneous rocks. Igneous rocks formed at some depth (*plutonic* rocks) will be coarse-grained; these are *intrusive* igneous rocks. Igneous rocks intruded at shallow depths (e.g., rocks formed in volcanic feeder dikes) will have a texture intermediate between that of extrusive and intrusive igneous rocks and are called *hyperbyssal*.

The difference in grain size is due to the cooling history of the rock. Extrusive rocks cool in the relatively cold and uninsulated environment of the earth's surface. On the other hand, the *country* rock (older rock intruded into by an igneous body) acts as an insulator, contributing to the slow cooling of intrusive rocks. Determining the texture is the first component for identifying igneous rocks.

Extrusive and intrusive igneous rocks are also divided into felsic, intermediate, and mafic compositions based on the amount of silica present. Felsic rocks are higher in the oxides SiO_2, K_2O, and NaO, while mafic rocks contain less SiO_2 and more CaO, MgO, and FeO. Identifying and estimating the amount and type of minerals present is the second component of identifying igneous rocks.

Part I Identification of Igneous Rocks (see Tables 3.1 & 3.2 in the lab manual)

Identify the following rocks based on composition and crystal size. A complete igneous rock name may require the addition of specific textural terms, such as *vesicular*, *porphyritic*, and *amygdaloidal*, i.e., amygdaloidal basalt, porphyritic rhyolite, pegmatitic granite (see pages 37-40 in your lab manual). You will be required to give the COMPLETE name on the test, **so give the complete name here!** Be sure to note any features that may help you identify these rocks on a test.

Rock #1: (Page 40)

A) What is the pink mineral? (1) _____.

What is the gray mineral? (1) _____

The brownish-black mineral has perfect basal cleavage, what mineral is it? (1) _____.

B) Estimate the amount of pink, gray and black minerals in this sample. (1 pt each)

Pink mineral: _____ %

White/light gray mineral: _____%

Brownish-black mineral: _____ %

C) What type of rock is it? (2) _____

D) What plate-tectonic setting (i.e., convergent, divergent, transform; see Fig. 3.18, pg 45) would you find this rock-type? (1)

_____

Rock #2: (Page 41)

A) Estimate the amount of white, gray and black minerals in this sample. (1 pt each)

Gray mineral: _____%

White/light gray mineral: _____%

Black mineral(s): _____%

B) What type of rock is it? (2) _____

Rock #3: (Page 41)

A) This rock is relatively heavy (compare to #6 or #1). It is made up of a calcic-plagioclase, the ferromagnesian minerals pyroxene and/ or amphibole, with possibly some olivine. Using Bowen's reaction series (Figure 3.17, pg. 44, lab manual) was the temperature of the magma high or low when this rock crystallized? (1)

_____

B) What type of rock is it? (2) _____

C) At what type of plate boundary (divergent, convergent, transform; see Fig. 3.18, pg 45) would this rock typically form at? (1)

_____

Rock #4:

A) This is the extrusive equivalent of Rock #1. What type of eruption (explosive or "quiet" would be associated with the extrusion of this rock **and** why? (3) _____

_____

B) What type of rock is it? (2) _____

C) At what type of plate boundary (divergent, convergent, transform; see Fig. 3.18, pg 45) would this rock form? (1)

_____

Rock #5: (Page 43)

A) This rock floats on water! Why? (Give a better reason than "It's light") (4) _____

_____

B) Is the rock more felsic or mafic in composition? (1) _____

C) How can you tell? (1) _____

D) What type of rock is it? (2) _____

Rock #6: (Page 38)

A) This is one of the few rocks that is not made up of minerals.

What type of fracture does it display? (1) _____

B) Is this rock *mafic* or *felsic*? (1) _____

C) What type of rock is it? (2) _____

Rock #7: (Page 43)

A) This rock is in some ways similar to sample #5, but won't float. Why not? (2) _____

_____

B) What type of rock is it? (2) _____

C) How did it form? (2) _____

Rock #8: (Page 42)

A) What texture does this rock display? (1) _____

B) What caused the holes in this rock to form? (2) _____

_____

C) What type of rock is it? (2) _____

D) *How* and *why* is this rock different from #7 when they have the same composition (***hefting*** would be useful!)? (2)

_____

Rock #9:

A) How can you tell that this rock has a composition intermediate between rhyolite and basalt? (1)

_____

B) What mineral is lacking from this type of rock, that is present in rhyolite? (1) _____

C) What type of rock is it? (2) _____

D) What plate-tectonic setting (i.e., convergent, divergent, transform; see Fig. 3.18, pg 45) would you find this rock-type? (1)

_____

Rock #10: (Pages 38 & 42)

A) What texture does this rock display? (1) _____

D) This rock is similar in composition to sample #8, but it contains large crystals instead of pore spaces. Why are these large crystals present? (2)

_____

What is the history of this rock after its parent magma formed? (3):

1. _____

2. _____

3. _____

C) What is the generic name given to the larger crystals? (1) _____

D) What mineral forms the larger crystals? (1) _____

E) What type of rock is it? (2) _____

Rock #11: Identify the 4 minerals that make-up this rock. Estimate the percentage of each mineral present:

Mineral 1: _____ _____%. (2)

Mineral 2: _____ _____%. (2)

Mineral 3: _____ _____%. (2)

Mineral 4: _____ _____%. (2)

What is this rock? (1) _____

Rock #12: The rock type is ***Dunite***. (Page 42)

A) What is the green mineral that makes up most of this rock? (1) _____

B) Using Bowen's reaction series, when would this rock crystallize (i.e., early or late stage crystallization) and what was the relative temperature (high, moderate, low) of the magma when it crystallized? (2)

_____

Part II Mystery Specimens

Identify the following mystery specimens (these are further examples of rocks that you have already identified in your lab set).

Rock #13 Name the rock (2): _____

What is the diagnostic property of this rock? (2) _____

Rock #14: Pyroclasts are projectiles that are launched from volcanoes during an eruption. Rock #14 is one type of projectile.

What is it? (2) _____

What type of volcano could it come from? (2) _____

Identify the following mystery specimen (ask the TAs for a specimen if it's not on your table**)**:

Rock #15 is a very coarse-grained intrusive igneous rock. The black mineral in this sample is ***tourmaline***, a common accessory component in granitic magmas. Identify the other 3 minerals that make up this rock (you may have to look at more than one specimen:

Mineral 1: _____ (1)

Mineral 2: _____ (1)

Mineral 3: _____ (1)

_____ Name this rock: _____ (2)

Rock #16: (page 38)
This rock has a distinctive texture. Examine the specimen and answer the following questions.

Is this an intrusive or an extrusive rock? (1) _____

What is the texture displayed by this sample? (1) _____

How did this texture form? (2) _____

_____