PLEASE read about the formation and classification of igneous rocks before you begin.

Igneous rocks are classified based on their texture and mineral makeup (p. 3). For fine-grained rocks, color is often the only basis for classification until minerals can be identified under the microscope. After these exploratory questions (some use labeled rocks at the back of the room), identify the rocks in drawer two (30-48) as best you can using the last page chart.

1. Determining the presence of quartz (qtz) will help you put the rock on the felsic to mafic spectrum. For the following samples, determine if qtz is present, and if it is, what %.
   A. 48 ____________
   B. 30 ____________
   C. 29 ____________

2. Determining the percentage of mafic (Fe & Mg as major components) minerals present will also help classify a rock. The minerals toward the bottom and right of the classification diagram below are mafic. (Augite, Hornblende, Biotite, Olivine).
   A. 31 ____________   Felsic minerals include Quartz, Orthoclase, and Muscovite.
   B. 32 ____________   Plagioclase runs the felsic to mafic continuum from the Na-rich
   C. 33 ____________   Albite with the felsics to the Ca-rich Labradorite with mafics.

3. Some fine-grained rocks have gone through a period of slow cooling before being extruded to the Earth’s surface for a second period of rapid cooling. These rocks have isolated phenocrysts surrounded by a fine-grained groundmass. The mineralogy of the phenocrysts in porphyritic rocks will help you identify them.
   A. Which of the rocks in your drawer are porphyritic? ___, ___, ___, ___, ___, ___
   B. ID the mineral in the phenocrysts in each sample.

________________________________________
________________________________________
________________________________________
________________________________________
________________________________________
4. Many volcanic rocks have special textures that help in the identification of the rock. Look at the samples in the back of the lab first then use the classification scheme to name samples (37-39,46) with volcanic textures.

A. Chunks of country rock that get caught up in the igneous magma during its ascent are called “xenoliths.” The dark patch in this sample is a piece of the country rock. Why was it not melted by the ascending magma?

B. This Hawaiian basalt has both vesicles and xenoliths. Some of them are deeper, mantle-sourced Peridotite xenoliths. What color/mineral are the mantle xenoliths?

C. This sample is a pyroclastic “bomb” of a particular variety known as a “breadcrust bomb” for obvious reasons. This Dacite piece erupted from Mt. St. Helens in a nearly crystallized state on the exterior, but expanded during further crystallization. What is Dacite?

D. This basalt from the Cactoctin Fm of the Blue Ridge used to have vesicles, but following the later burial of this rock, water passing through the rock filled the voids with minerals. The vesicles are now called “amygdules.” What mineral are they?

5. Amphibole (hornblende is one) and pyroxene (augite is one) are difficult to identify as small grains even using a hand lens. Most important is the difference in cleavage and grain crystal habit. Amphiboles have two cleavage planes not at 90° and tend to form long thin grains. Pyroxene has two cleavage planes at roughly 90° and tends to form “boxy” grains (equidimensional). Hornblende has a shiny dark black color whereas Augite is a dull greenish black. Biotite is also shiny dark black, but it is soft and will cleave. HOWEVER, the luster and color varies a good deal for pyroxenes and amphiboles other than the two you are learning. So these are just generalizations. What is the black mineral in the following samples?

A. 44
B. 48
C. 40

6. Can you tell the difference between Orthoclase and Plagioclase, and between Na-plagioclase and Ca-plagioclase? Look at these samples with a hand lens and ID the feldspar using the following guidelines. K-feldspar (orthoclase) has two cleavage planes at 90°, forms equant grains and is generally milky-white, or orange-to-pink. Plagioclase is characterized by twinning (striations) on cleavage planes and lath-shape (rectangular) grains. Na-plagioclase (albite) is white and minerals at the Ca-plagioclase end tend to be darker.

A. 33
B. 48
C. 32
D. 45
E. on back table (tricky rock..do your best..)
Here are charts you can use to help you name the rocks from the fieldtrip. Peridotite is the rock that forms most of the upper mantle and is therefore infrequently found at the Earth’s surface. The sample in your drawer is particularly. . .um. . . grungy and weathered.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Felsic</th>
<th>Intermediate</th>
<th>Mafic</th>
<th>Ultramafic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz?</td>
<td>Lots &gt; 10%</td>
<td>Little (&lt;5%) Or None</td>
<td>No Quartz</td>
<td>No Quartz</td>
</tr>
<tr>
<td>Major Feldspar</td>
<td>Orthoclase + Na-Plag</td>
<td>Na-plagioclase (light colored)</td>
<td>Ca-plagioclase (dark colored)</td>
<td>Some Ca-plag but nearly all Olivine+ Pyroxene</td>
</tr>
<tr>
<td>Phenocrysts</td>
<td>Biotite, Qtz, K-Feldspar, Hornblende</td>
<td>Plagioclase</td>
<td>Olivine Ca-Plagioclase</td>
<td>-- (not extrusive)</td>
</tr>
<tr>
<td>% mafic minerals</td>
<td>5-25</td>
<td>≈ 50</td>
<td>&gt; 50</td>
<td>100</td>
</tr>
<tr>
<td>Appearance</td>
<td>Pink to Light Grey</td>
<td>Salt ‘n Pepper</td>
<td>Black</td>
<td>Greenish Black</td>
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<tr>
<td>Name Intrusive</td>
<td>Granite</td>
<td>Diorite</td>
<td>Gabbro</td>
<td>Peridotite</td>
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<tr>
<td>Extrusive</td>
<td>Rhyolite</td>
<td>Andesite</td>
<td>Basalt</td>
<td></td>
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</tbody>
</table>

Special Textures
- Glassy: Obsidian
- Vesicular: Felsic: Pumice
- Mafic: Scoria
- Pyroclastic: Tuff (no sample)

Modifying Textures
- Two grain sizes: _______Porphyry
- Large crystals: _______Pegmatite
- for example: Andesite porphyry

This chart shows the kind and relative abundance of the different minerals in igneous rocks from felsic to ultramafic). Note the range in each! Ultramafic rocks are only formed in the mantle.
Key

1. Qtz
   A. 48 10-20 % quartz
   B. 30 < 5 %
   C. 29 none, trick rock, a non-quartz felsic rock called a “syenite”

2. ferromag %
   A. 31 about 50 %
   B. 32 15%

3. phenocrysts
   A. 35, 36, 40, 41, 43, 47
   B. 35, Na-Plagioclase, hornblende
      36, K-feldspar (white orthoclase)
      40 qtz, hornblende
      41 K-feldspar (Orthoclase)
      43 K-feldspar (Orthoclase); this sample is from near Mt. Rogers in SW VA and has likely been metamorphosed. It is quite dark for its type.
      47 Ca-plagioclase – make SURE you can see the striations.

4. volcanic textures
   A. It didn’t melt because it is more mafic than the felsic magma (that cooled to make the felsic rock).
   B. it is green because of the olivine, also has a black pyroxene.
   C. Dacite is an extrusive rock with a composition between rhyolite and andesite
   D. K-feldspar on the rim and Na-plagioclase and/or epidote (a green, metamorphic mineral) toward the centers.
   E. 37 obsidian
   F. 38 pumice (frothy lava)
   G. 39 scoria
   H. 46 vesicular basalt

5. dark mineral ID
   A. 44 biotite
   B. 48 amphibole (hornblende)
   C. 40 amphibole (hornblende)

6. f***ing feldspars
   A. 33 Ca-plagioclase (anorthite)
   B. 48 Na-plagioclase (albite)
   C. 32 Na-plagioclase
   D. 45 K-felspar (orthoclase) - there are no striations
   E. these “rapakivi granites” from a sea-kayaking day in Maine are characterized by large orthoclase crystals rimmed by plagioclase, likely because the magma changed chemistry during the cooling due to the addition of a magma of a different chemical composition.
<table>
<thead>
<tr>
<th>Num</th>
<th>Texture?</th>
<th>Minerals</th>
<th>Chemistry</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>intrusive</td>
<td>no quartz, orthoclase, Na-plagioclase &amp; hornblende</td>
<td>Felsic</td>
<td>syenite (a qtz-free granite)</td>
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<td>30</td>
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<td>36</td>
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<td>white __________ phenocrysts</td>
<td>Felic, mafic(?) groundmass</td>
<td>Felsic porphyry</td>
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<td>3 phenocrysts, can you ID them?</td>
<td>felsic</td>
<td>rhyolite porphyry</td>
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<td>extrusive, porphyritic</td>
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