Name: _____ Course/Section: _____ Date: _____

A Analyze the igneous rocks in Fig. A5.1.1 (and actual rock samples of them if available). They are depicted at approximately the same size as they are in nature. Beneath each picture, describe the rock's **color**, **composition** (what it is made of), and **texture** (the size, shape, and arrangement of its parts) as well as you can, using your current knowledge.

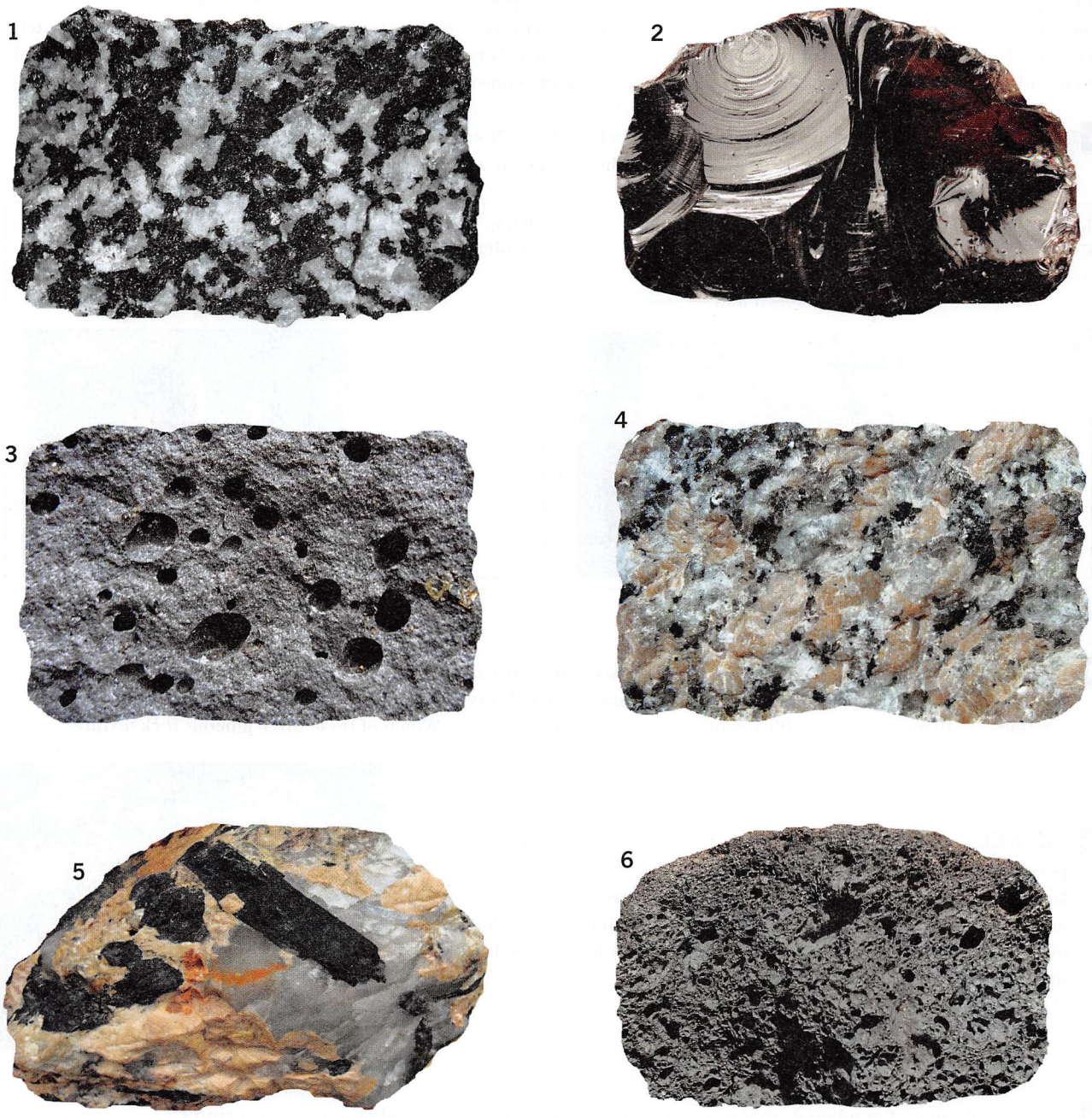


Figure A5.1.1

B **REFLECT & DISCUSS** Describe how you would classify the rocks in part A into groups. Be prepared to discuss your classification with your classmates.

Activity 5.2 Crystalline Textures of Igneous Rock

Name: _____ **Course/Section:** _____ **Date:** _____

Two students are doing an experiment to find out if crystal size in igneous rocks can be related to the speed of cooling a magma. They did not have equipment to melt rock, so they used thymol to model pieces of rock. Thymol melts easily at low temperature on a hot plate, and it cools and recrystallizes quickly. Thymol is a transparent, crystalline organic substance derived from the herb thyme and is used in antiseptics and disinfectants. Thymol gives off a very strong pungent odor that can irritate skin and eyes and cause headaches. Therefore, the students used a spoon to handle the thymol and did all of their work under a fume hood with supervision from their teacher. One of the students placed some thymol in a small Pyrex beaker and melted it completely under a fume hood to model the formation of magma. The other student poured one-half of the molten thymol into a cold petri dish and the other half into a hot petri dish of the same size.

A The results of the student's experiment are shown in Fig. A5.2.1. Notice that the images are enlarged. Beside each image below, measure and record the actual size range of the crystals (in mm) that formed.

Molten thymol in the cold petri dish crystallized in 1 minute and looked like this enlarged view.

5 mm

Actual size of the crystals in mm is:

Molten thymol in the hot petri dish crystallized in 3 minutes and looked like this enlarged view.

5 mm

Actual size of the crystals in mm is:

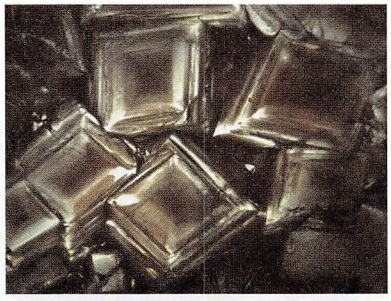


Figure A5.2.1

B Igneous rocks that are made of crystals too small to see with your naked eyes or hand lens are said to have an **aphanitic** texture (from the Greek word for unseen). Those made of visible crystals are said to have a **phaneritic** texture (crystals ~1–10 mm) or **pegmatitic** texture (crystals greater than 1 cm). Which of these three igneous rock textures probably represents the most rapid cooling of magma/lava?

C **REFLECT & DISCUSS** The rock shown in Fig. A5.2.2 has a **porphyritic** texture, which means that it contains two sizes of crystals. The large white plagioclase crystals are called **phenocrysts** and sit in a green-gray **groundmass** of more abundant, smaller (aphanitic) crystals. Based on your work in part A, explain how this texture may have formed. More than one potentially correct answer is possible.

Figure A5.2.2

D In your collection of numbered igneous rock samples, record the sample numbers with these textures:

Sample(s) with porphyritic texture:	Sample(s) with phaneritic texture:
Sample(s) with pegmatitic texture:	Sample(s) with aphanitic texture:

Glassy and Vesicular Textures of Igneous Rock

Activity 5.3

Name: _____ Course/Section: _____ Date: _____

Place equal parts of sugar (sucrose, $C_{12}H_{22}O_{11}$) and water in the pan/beaker and heat on medium high. Do not touch the hot plate, beaker/pan, or boiling sugar because it is very hot! Notice that steam is given off after the sugar dissolves and the solution boils. After a few minutes, there will be no more steam, and the remaining molten sugar will have a very thick consistency. At this point (and before the sugar begins to burn), pour the thick molten sugar onto a piece of aluminum foil on a flat table. DO NOT TOUCH the molten sugar, but lift a corner of the foil to observe how it flows and behaves until it hardens over a time of perhaps 2–3 minutes.

A Viscosity is a measure of how much a fluid resists flow. Water has low viscosity. Honey is more viscous than water. How did the viscosity of the sugar solution change as the water boiled off?

B What happened to the viscosity of the molten sugar as it cooled on the aluminum foil?

C When the molten sugar has cooled to a solid state, break it in half and observe its texture. Look about the room where you are now seated and name two objects that have this same texture.

D Now observe the texture of the cooled solid mass of sugar with a hand lens. Notice that there are some tiny holes within it formed by bubbles of gas. Geoscientists call these holes **vesicles**, and rocks containing vesicles are said to have a **vesicular** texture. What prevented the gas bubbles from escaping to the atmosphere?

E **REFLECT & DISCUSS** When a sugar solution is permitted to slowly evaporate, sugar crystals form. The process of crystallization depends on the ability of atoms to move about in the solution and bond together in an orderly array. What two things may have prevented crystals from forming in the molten sugar as it cooled on the aluminum foil in this experiment?

F In your collection of numbered igneous rock samples, do any of the samples have the texture that you just observed in part C? If yes, which one(s)?

G In your collection of numbered igneous rock samples, do any of the samples have the texture that you just observed in part D? If yes, which one(s)?

Activity 5.4 Minerals That Form Igneous Rock

Name: _____ Course/Section: _____ Date: _____

A Using information from the section "Composition of Common Igneous Rocks" to identify the minerals in Fig. A5.4.1. Below each picture, write the **name of the mineral**, its **chemical composition** (chemical formula or chemical name), and **a description** that would allow you to recognize it in the future. All samples are shown at approximately their actual size.

augite (pyroxene)	biotite mica	hornblende (amphibole)	muscovite mica
olivine	plagioclase feldspar	potassium-rich alkali feldspar	quartz

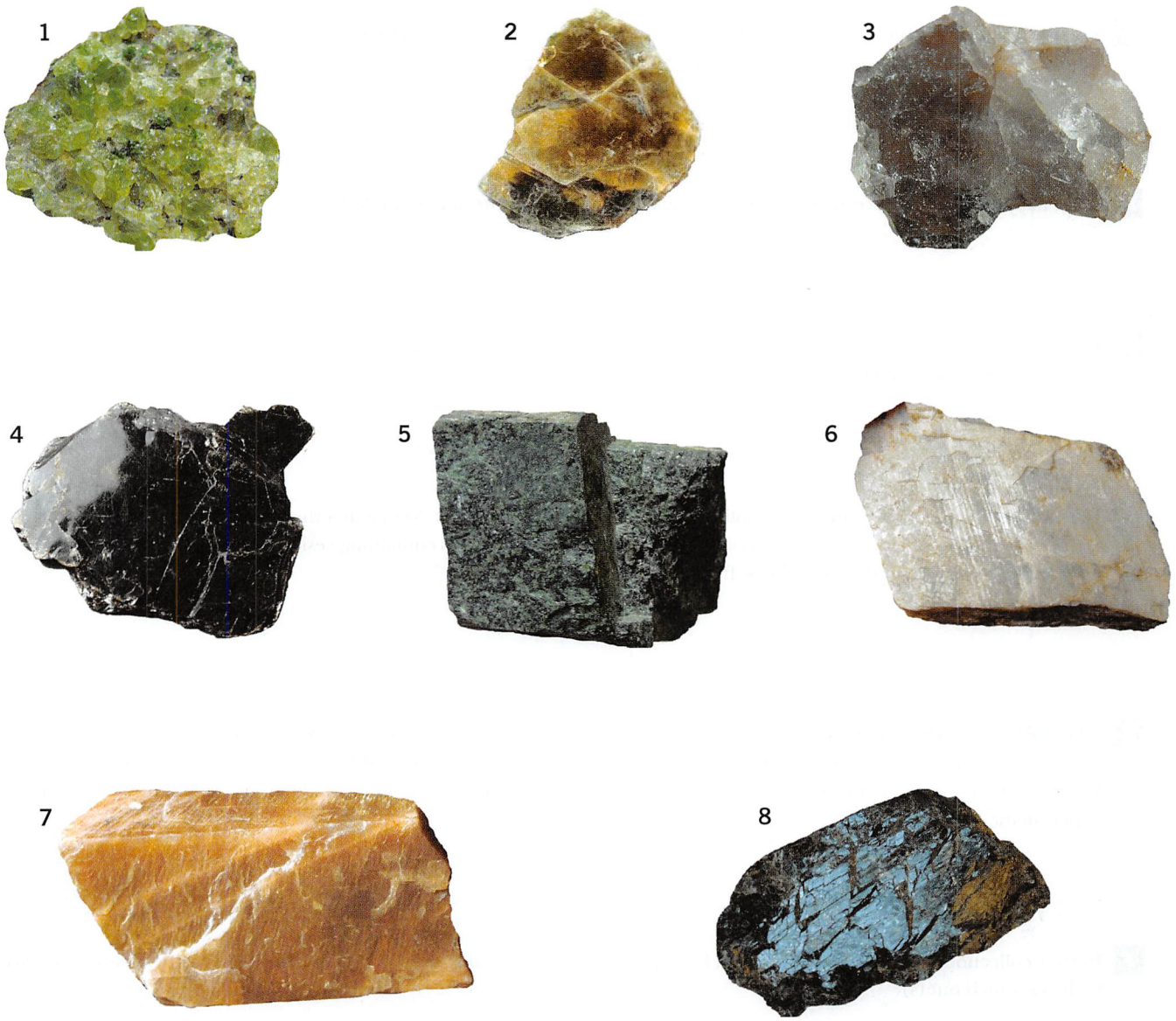


Figure A5.4.1

B **REFLECT & DISCUSS** Which specific minerals are mafic and which ones are felsic? How do you know?

Estimate the Percentage of Mafic Minerals

Activity 5.5

Name: _____ **Course/Section:** _____ **Date:** _____

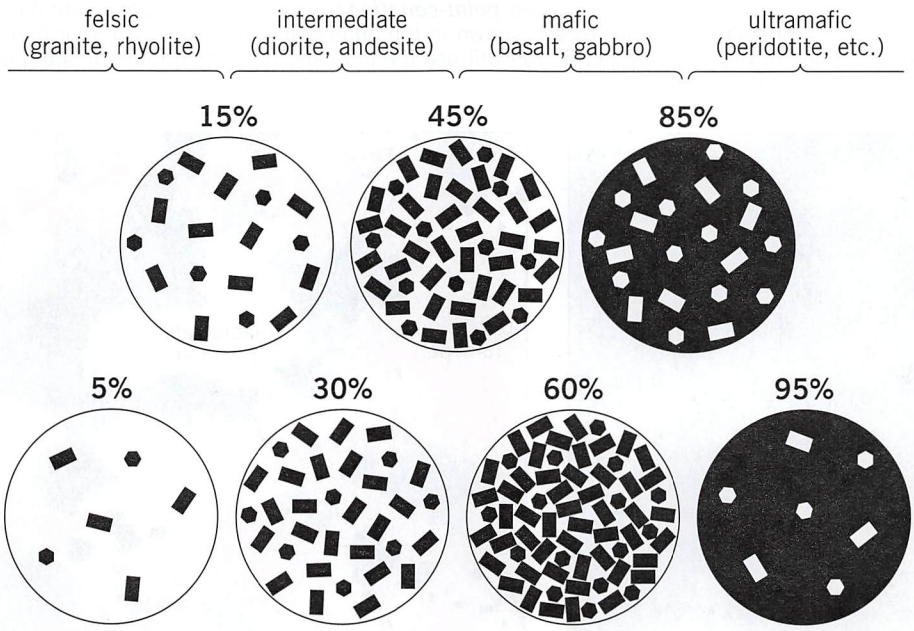
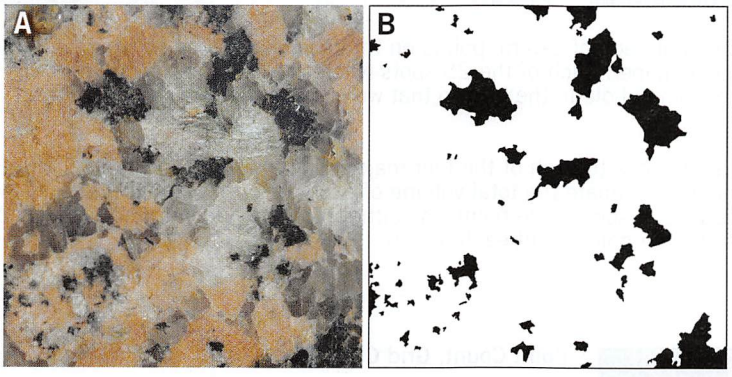


Figure A5.5.1



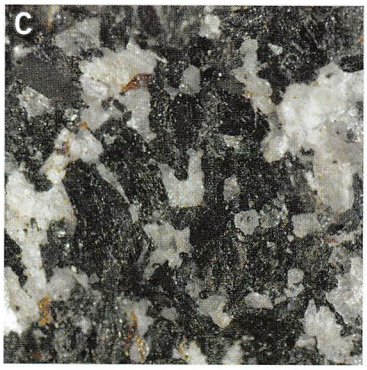
The mafic minerals in photo A are shown as black areas in map B. Use the scale above to estimate the percentage of mafic minerals in this rock.

mafic %: _____

Based on your estimate, describe this rock as felsic, intermediate, mafic, or ultramafic.

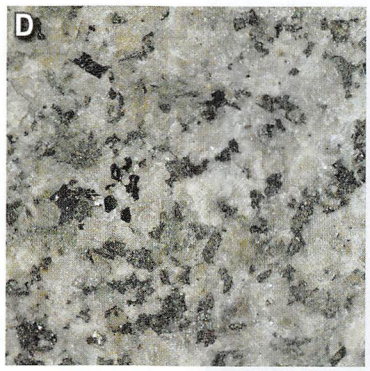
_____

Now do the same analysis for the three rocks shown below.



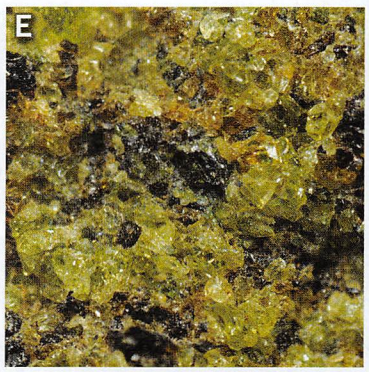
mafic %: _____
rock description:

_____



mafic %: _____
rock description:

_____



mafic %: _____
rock description:

_____

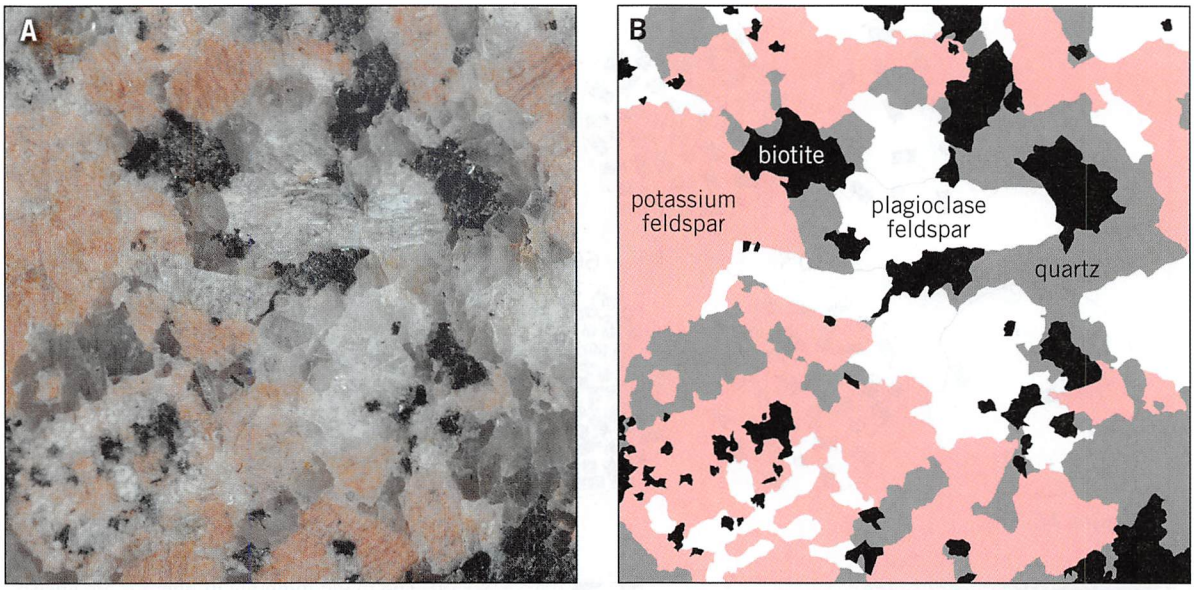
Figure A5.5.2

Activity 5.6

Estimate Mineral Composition of a Phaneritic Rock by Point Counting

Name: _____ **Course/Section:** _____ **Date:** _____

Geologists sometimes classify rocks using a technique called ***point-counting*** to estimate the relative abundance of different minerals in a rock. A phaneritic igneous rock is shown in the photograph marked A. The four major minerals in the rock are identified in the map marked B. You will use the map and a point-counting technique adapted for this lab to classify the rock.



The basic idea is to identify the mineral found at each of several points on the rock. We draw a square grid with 5 vertical and 5 horizontal lines on some opaque paper. Each of the 25 spots where the grid lines cross will be called a node. At each ***node***, we will create a small hole in the grid so that we can see the map of the rock through the hole.

We count the number of node points that are filled with each of the four major minerals (that is, with each of the four colors on the map), and use that number to estimate the total volume of each major mineral in the rock. You can see more than one mineral through the hole at some node points, so either pick the mineral that fills most of the hole, or if two minerals each fill about half the hole, count each as 0.5.

Figure A5.6.1

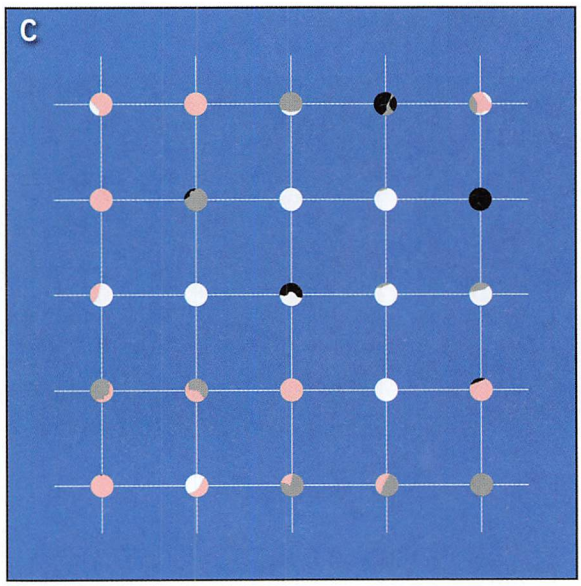


Figure A5.6.2

Point Count, Grid C

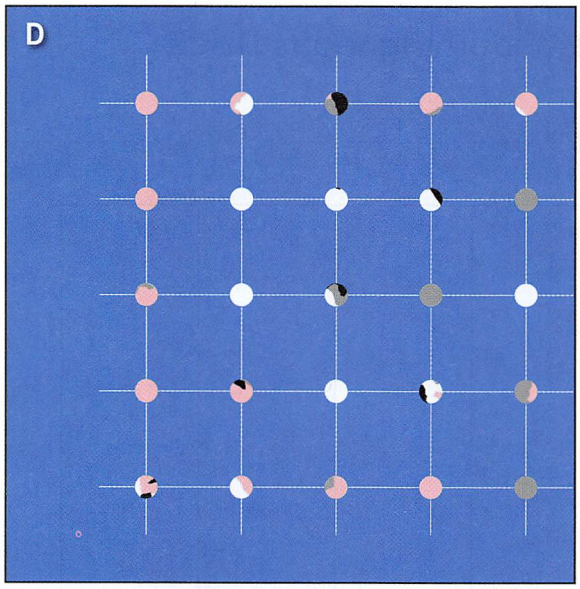
Number of nodes filled with the mineral

(_____ x 4) = _____ % potassium feldspar (pink)

(_____ x 4) = _____ % plagioclase feldspar (white)

(_____ x 4) = _____ % quartz (gray)

(_____ x 4) = _____ % biotite (black)



How reliable was that sample of 25 points as a way to estimate the modal composition of the rock? Let's see.

The grid has been shifted in three different ways, so we can sample three different sets of points. Repeat the point count for each of these three grids.

Point Count, Grid D

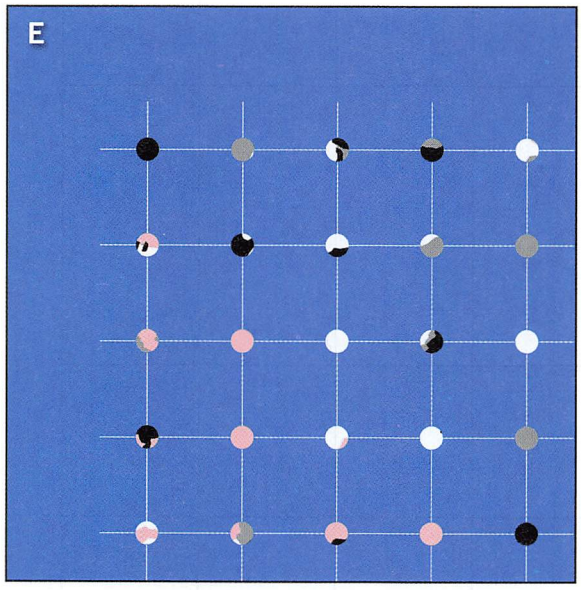
Number of nodes filled with the mineral

(_____ x 4) = _____% potassium feldspar (pink)

(_____ x 4) = _____% plagioclase feldspar (white)

(_____ x 4) = _____% quartz (gray)

(_____ x 4) = _____% biotite (black)



Point Count, Grid E

(_____ x 4) = _____% potassium feldspar (pink)

(_____ x 4) = _____% plagioclase feldspar (white)

(_____ x 4) = _____% quartz (gray)

(_____ x 4) = _____% biotite (black)

Point Count, Grid F

(_____ x 4) = _____% potassium feldspar (pink)

(_____ x 4) = _____% plagioclase feldspar (white)

(_____ x 4) = _____% quartz (gray)

(_____ x 4) = _____% biotite (black)

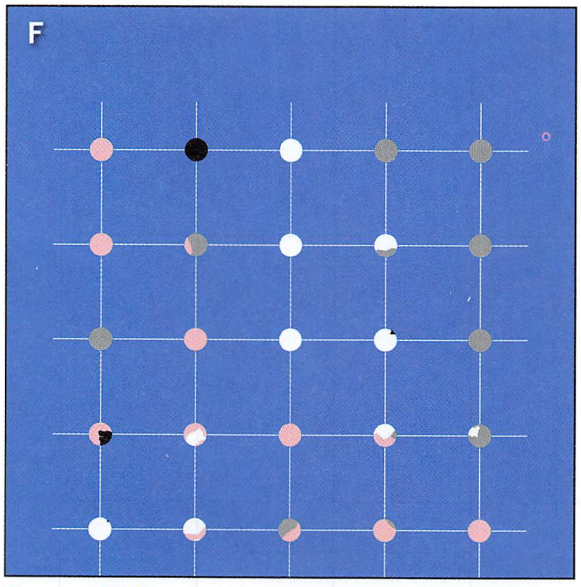


Figure A5.6.2 (*continued*)

Use the data from the point counts of grids D, E, and F to complete the following table.

	average	standard deviation
potassium feldspar		
plagioclase feldspar		
quartz		
biotite		

Do the results of your point count of grid C on the previous page fall within one standard deviation of the average of grids D, E, and F for each of the major minerals? Explain...

What type of phaneritic igneous rock is shown in photograph A?

Activity 5.7 Analysis and Interpretation of Igneous Rock

Name: _____ Course/Section: _____ Date: _____

IGNEOUS ROCKS WORKSHEET

Sample number or letter	Texture(s) present	Minerals present and their percentage of abundance.	Estimate the percentage of mafic minerals.	Rock names (Figures 5.4, 5.6, 5.15, 5.16).	Describe a geological environment where this rock might have formed (intrusive vs. extrusive, etc).

Name: _____ Course/Section: _____ Date: _____

IGNEOUS ROCKS WORKSHEET

Sample number or letter	Texture(s) present	Minerals present and their percentage of abundance.	Estimate the percentage of mafic minerals.	Rock names (Figures 5.4, 5.6, 5.15, 5.16).	Describe a geological environment where this rock might have formed (intrusive vs. extrusive, etc).

Activity 5.8 Geologic History of Southeastern Pennsylvania

Name: _____ **Course/Section:** _____ **Date:** _____

Review **Fig. 5.19**. Then study the portion of a geologic map of Pennsylvania in Fig. A5.8.1. The green-colored areas are exposures of 200–220 million-year-old Mesozoic sand and mud that were deposited in lakes, streams, and fields of a long, narrow valley. The red-colored areas are bodies of basalt about 190 million years old. Paleozoic and Precambrian rocks are more than 252 million years old and colored pale brown.

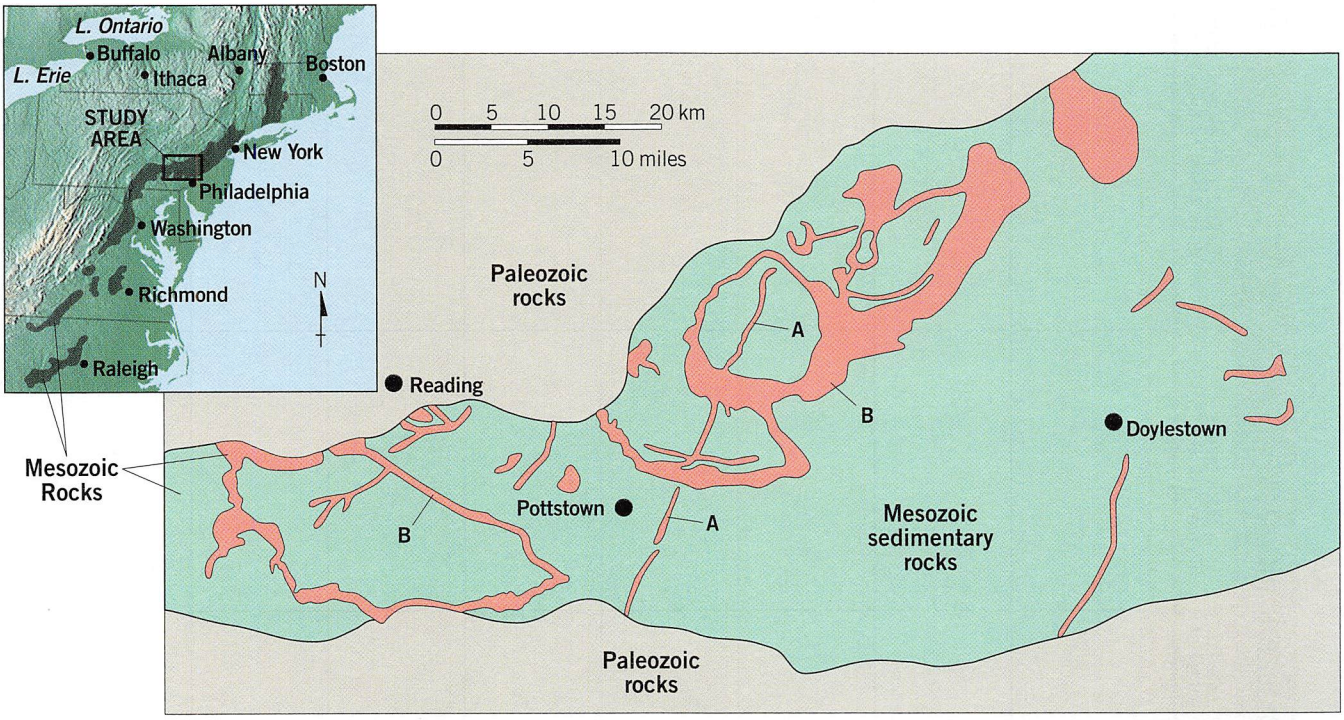


Figure A5.8.1

A Based on their geometries (as viewed from above in map view), what kind of igneous bodies on the map are labeled A?

B Based on their geometries (as viewed from above in map view), what kind of igneous bodies on the map are labeled B (more than one answer is possible)?

C **REFLECT & DISCUSS** If you could have seen the landscape that existed in this part of Pennsylvania about 200 million years ago (when the bodies of igneous rock were lava), what else would you have seen on the landscape besides valleys, streams, lakes, and fields? Explain your reasoning.