Mineral Identification

Your Geosc 001 instructors, Eliza and Dave, along with your Geosc 001 TAs, Emily and Brett, were invited to President Spanier's house to watch the Orange Bowl. Each of them brought a collection of the same five minerals so they could all compare their specimens with President Spanier's specimens after the game. During regulation (before the three overtimes), another jealous party-goer who wished he were a geologist so he could own cool mineral samples stole one mineral from each of their collections, including from President Spanier's collection. He then hid the minerals somewhere in the President's house. Eliza is missing her quartz sample, but she still has her potassium feldspar, magnetite, biotite, and calcite. Each of the others is also missing one mineral specimen. You have been given a box that contains samples of all five minerals. Your job is to identify each mineral in the box and, using the clues below, determine which mineral was stolen from which person, when during the game it was stolen, and where in the house it was hidden.

1. Neither Eliza nor Emily was missing a mineral during the first quarter of the game.
2. The **mineral that reacts to a weak solution of hydrochloric acid** (see page 3) was not found in the bedroom or the bathroom.
3. Emily and Eliza looked in the bedroom and bathroom with no luck after Emily found her mineral was missing during halftime.
4. The **mineral with a metallic luster** (see page 3) went missing during the third quarter.
5. The person missing the **mineral that makes a dark streak on the streak plate** (see page 4) and the person whose mineral went missing during the first quarter both told Brett that they were worried about Florida State's potential for making big plays during punt returns.
6. Brett was glad no one stole his **mineral that has the unique property of double refraction** (see page 4) or his **mineral with the "platy" crystal habit** (see page 5) but he was shocked to discover his mineral missing early in the game.
7. The person missing the **mineral with one direction of cleavage** (see page 5) was relieved when someone who had to leave the party early found it in the coat closet after the first quarter.
8. It was during the fourth quarter that Eliza found her **mineral whose hardness is $\approx$ 7 on the Mohs scale** (see page 5) missing. She checked everywhere, even the kitchen, but it wasn't until after the 3rd overtime that anyone looked in the wine cellar and found it there.
9. The person missing the **magnetic mineral** (see page 7) did not find it in the bathroom.
10. Graham Spanier was relieved when he tripped over his missing mineral in the bedroom.

Which mineral in your box is which?

1.
2.
3.
4.
5.

	quartz	kspar	magnetite	biotite	calcite	1st	2nd	half	3rd	4th	bedroom	bath	closet	kitchen	cellar
Eliza															
Dave															
Emily															
Brett															
Graham															
bedroom															
bathroom															
closet															
kitchen															
cellar															
1st															
2nd															
half															
3rd															
4th															

Summing Up

Person	Mineral	When	Where

Dissolution of Minerals

Only a few minerals, like halite, are highly soluble in pure water. Most minerals do not noticeably dissolve in water, even after weeks or months. But in a weak acid, many minerals dissolve. This happens because the acid breaks the bonds that hold the mineral's atoms together within the mineral's crystal structure. Acid contains hydrogen ions, which are good at breaking chemical bonds in certain minerals, particularly carbonate minerals. These minerals release carbon dioxide gas (CO_2) as they dissolve in the acid.

In this exercise you will test the solubility of your five minerals in a weak solution of hydrochloric acid. Although the acid is weak, don't get it on your hands or clothes. Flush your eyes with water if you get any acid in them. Record your observations in the table below.

Mineral	Did gas form?	If yes, fast or slow?	Fizzing sound?	Other observations
1				
2				
3				
4				
5				

Calcite is calcium carbonate ($CaCO_3$). All carbonate minerals have relatively weak bonds, so they dissolve in even the weakest acids. This dissolution is commonplace in nature because ordinary rainwater generally is slightly acidic. The natural source of the acidity in rainwater is carbon dioxide gas. Carbon dioxide is a natural part of Earth's atmosphere, and it dissolves into raindrops to form weak carbonic acid. Calcite is the only one of your five samples that is a carbonate mineral. Based on the experiment you just did, which one is it?

Fill this information in the table on page 1.

Luster

4.1 *Luster* is a description of how light is reflected off a mineral. The two basic categories of luster are *metallic* and *non-metallic*. Within the non-metallic category are several other

descriptors, such as *glassy, earthy (dull), pearly, silky,* or *resinous.* Try to classify each of your five samples in terms of these descriptors.

Mineral	Luster	If non-metallic, other description
1		
2		
3		
4		
5		

The only mineral of your five with a metallic luster is magnetite. Which one is it?

Fill this in the table on page 1.

Color and Streak

Using the streak plates, scratch each mineral along the plate to determine its streak color, if any.

Mineral	Mineral color	Streak color
1		
2		
3		
4		
5		

Double Refraction

Take each of your transparent mineral samples and put them down on a piece of paper with text or a line drawn on it. Which one of them splits the image into two images?

Crystal Habit

The atomic structure (the arrangement of the crystal lattice) of a mineral determines its *habit*, the shape into which it grows. Habit is generally a geometric description, such as "cubic", or "fibrous", or "prismatic", etc. Try to describe the habit of each of your samples.

Mineral	Crystal Habit
1	
2	
3	
4	
5	

Cleavage

The atomic structure (the arrangement of the crystal lattice) of a mineral also determines its *cleavage*, the shape into which it breaks. Note that habit and cleavage may be different. Often a mineral will grow in one shape, but it will fracture in another shape based on where its lattice bonds are weak. Crystals often break in a way that produces one or more smooth sides.

Refer to the rock and mineral id sheets for examples of different types of cleavages. Some minerals have no preferred shape when they break and these are defined as having no cleavage. Try to describe the cleavage (if present) of each of your mineral samples.

Mineral	Cleavage
1	
2	
3	
4	
5	

Hardness

Refer to the following two tables for help with this exercise. Use your fingernails and the penny, steel nail, glass plate, and streak plate provided to fill in hardness estimates for the

samples in the third chart below. By the way, scratch the plates with the minerals instead of the other way around, or else you might break the plates.

Mohs scale of hardness for some minerals

Hardness	Mineral
10	diamond (hardest mineral on earth)
9	corundum (includes rubies and sapphires)
8	topaz and beryl (includes emeralds)
7	quartz
6	orthoclase (potassium feldspar)
5	apatite (this is in your teeth)
4	fluorite
3	calcite
2	gypsum (used in stonewashed jeans)
1	talc (used in talcum powder)

Mohs scale of hardness for some common materials

Hardness	Material
≈ 7	ceramic streak plate
6.5	hardened steel file
5.5	window/bottle glass
5-6	steel nail
≈ 4	common wire nail
≈ 3	U.S. penny
≥ 2	fingernail

Sample	Mohs Hardness estimate	Explain (harder than what? softer than what?)
1		
2		
3		
4		
5		

Magnetism

Using the magnet, test to see which of your minerals is magnetic. Perhaps it is obvious already from the name of the mineral.