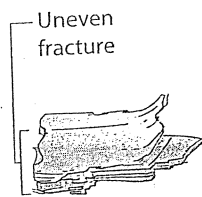
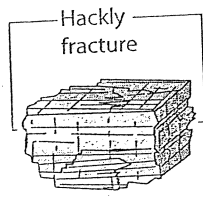


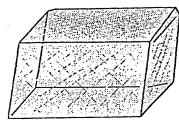
A Muscovite mica



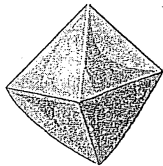
B Pyroxene augite



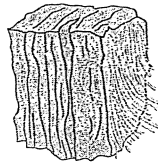
C Calcite



D Fluorite



E Amphibole asbestos



F Quartz

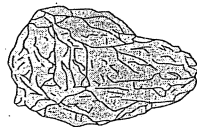


Figure 11-6. Types of cleavage and fracture: (A) shows one direction of cleavage and some uneven fracture. (B) shows two directions of cleavage and a hackly (bumpy) fracture. (C) shows three directions of cleavage. (D) shows four directions of cleavage. (E) shows fibrous fracture. (F) shows curved fracture.

Digging Deeper

A few minerals have very fine lines—called striations—on cleavage surfaces and on the faces of their crystal form. These striations can be used to distinguish the mineral plagioclase feldspar from the potassium feldspars such as orthoclase. Striations are an outward expression of the internal arrangement of the atoms within a mineral.

material very useful in making knives and arrowheads. Often a mineral will have both cleavage and fracture on different sides, such as the silicates hornblende and the feldspars. (See Figures 11-4 and 11-6)

Crystal Structure The outward geometric shape of a mineral, the crystal form, or **crystal shape**, reflects the crystal structure—orderly arrangement of the atoms in the mineral. It is only when individual mineral grains have the room to freely grow that this crystal shape, with its smooth sides or faces, can take shape. This is the reason most mineral samples found in nature don't illustrate the crystal forms; the use of crystal form in mineral identification is limited. Another problem is that even though the internal crystal structure of minerals is unique, the outward crystal shape, such as the cubic shape of halite, galena, and fluorite, isn't unique. Also, any mineral can have many different crystal shapes.

Other Mineral Properties Besides physical properties, some chemical properties of minerals are also used for identification. One of these chemical properties is the reaction of a mineral with acid. When a small amount of dilute hydrochloric acid is placed on a mineral or rock containing calcite (CaCO_3), the mineral or rock will bubble (effervesce)—giving off carbon dioxide. The mineral dolomite can be distinguished from calcite, because dolomite will bubble in acid only after the mineral is powdered.

Many other chemical and physical properties are used to identify minerals. Many of the properties only apply to a few minerals and will often be the key to a mineral's identification. For example, some minerals such as thin pieces of muscovite and biotite micas are flexible. This means that they can be bent and will snap back to their original shape. Other properties used for identification are found in Properties of Common Minerals in the *Earth Science Reference Tables*.

Review Questions

- A mineral CANNOT be
 - organic
 - crystalline
 - a solid
 - formed in nature
- Which rock is usually composed of several different minerals?
 - rock gypsum
 - limestone
 - quartzite
 - gneiss
- Only a small number of Earth's minerals are commonly found in rocks. This fact indicates that most
 - minerals weather before they can be identified
 - minerals have properties that are difficult to identify
 - rocks have a number of minerals in common
 - exposed surface rocks are mostly igneous

4. The data table shows the composition of six common rock-forming minerals.

Mineral	Composition
Muscovite Mica	$KAl_3Si_3O_{10}$
Olivine	$(FeMg)_2SiO_4$
Orthoclase	$KAlSi_3O_8$
Plagioclase	$NaAlSi_3O_8$
Pyroxene	$CaMgSi_2O_6$
Quartz	SiO_2

The data table provides evidence that

- (1) the same elements are found in all minerals
 - (2) a few elements are found in many minerals
 - (3) all elements are found in only a few minerals
 - (4) all elements are found in all minerals
5. What are the four most abundant elements, by volume, in Earth's crust?
- (1) oxygen, potassium, sodium, and calcium
 - (2) hydrogen, oxygen, nitrogen, and potassium
 - (3) aluminum, iron, silicon, and magnesium
 - (4) aluminum, calcium, hydrogen, and iron
6. Diamonds and graphite are both minerals that are composed of the element carbon. Diamond has a hardness of 10, while graphite has a hardness of 1. Based on your knowledge of earth science, what is the most probable cause of this difference in hardness?
7. Minerals are composed of
- (1) one or more rocks
 - (2) only one rock
 - (3) one or more chemical elements
 - (4) only one metal
- The cubic shape of a mineral crystal is most likely the result of that crystal's
- (1) hardness
 - (2) density distribution
 - (3) internal arrangement of atoms
 - (4) intensity of radioactive decay

9. The following diagrams represent four different mineral samples.



Which mineral property is best represented by the samples?

- (1) density
 - (2) cleavage
 - (3) hardness
 - (4) streak
10. Minerals are identified on the basis of
- (1) the method by which they were formed
 - (2) the type of rock in which they are found
 - (3) the size of their crystals
 - (4) their physical and chemical properties
11. A six-sided mineral crystal is a very hard mineral called
- (1) hornblende
 - (2) orthoclase feldspar
 - (3) quartz
 - (4) biotite mica
12. The relative hardness of a mineral can best be tested by
- (1) scratching the mineral across a glass plate
 - (2) squeezing the mineral with calibrated pliers
 - (3) determining the density of the mineral
 - (4) breaking the mineral with a hammer
13. What property would a mineral have if it appears like a new quarter in reflected light?
- (1) a metallic luster
 - (2) metallic element composition
 - (3) magnetic
 - (4) a high density
14. Which property of the mineral diamond allows diamond powder to be used to shape gems for jewelry?
- (1) crystal shape
 - (2) cleavage
 - (3) luster
 - (4) hardness
15. What information about a mineral is needed to determine its density?
- (1) shape and volume
 - (2) shape and mass
 - (3) volume and mass
 - (4) volume and hardness

ACHIEVE!

cks
ck is any naturally formed solid on Earth or in any part of the
erse. The definitions for rock and the individual rock types are not
ly as specific as those for a mineral. The reason is that rocks, except