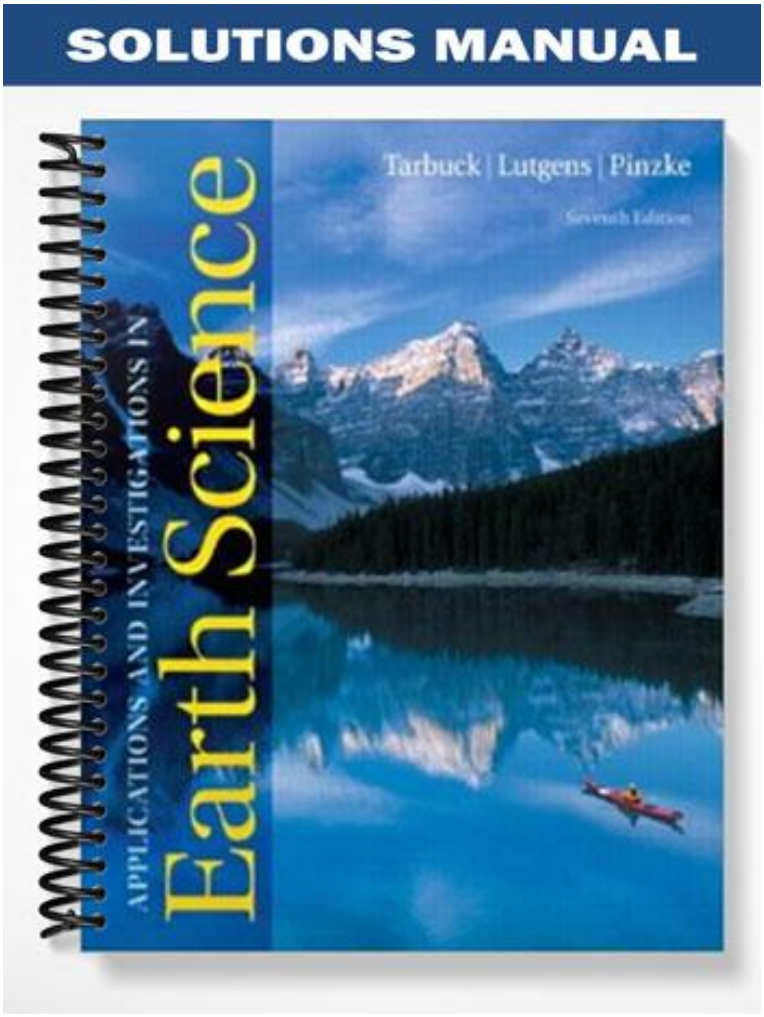
SOLUTIONS MANUAL



INSTRUCTOR MANUAL

Stanley C. Hatfield

Southwestern Illinois College

Applications and Investigations in Earth Science

Seventh Edition

Tarbuck | Lutgens | Pinzke

Exercise One

The Study of Minerals

MATERIALS REQUIRED

The following materials are necessary to complete this exercise and should be available in the laboratory. The quantities depend upon the number of students in the laboratory and whether or not students are to work independently or in groups.

mineral samples	dilute hydrochloric acid (5%)
streak plate	hand lens
magnet	glass plate

NOTE:

Depending upon the size and quality of the mineral specimens, using a hand lens often helps reduce student frustration.

Recommended mineral specimens: magnetite, pyrite, hematite, graphite, augite, hornblende, smoky quartz, olivine, sphalerite, biotite, potassium feldspar, plagioclase feldspar, milky quartz, calcite, halite, fluorite, muscovite, selenite gypsum, talc, bauxite

TEXTBOOK REFERENCES

Tarbuck and Lutgens, *Earth Science*, 12th edition, 2009. Chapter 2

Tarbuck and Lutgens, *Earth Science*, 11th edition, 2006. Chapter 2

Lutgens and Tarbuck, *Foundations of Earth Science*, 5th edition, 2008. Chapter 1 and Appendix B

Murphy and Nance, *Earth Science Today*, 1999. Chapters 2 and 17; Appendix C

Skinner and Porter, *The Blue Planet*, 2nd edition, 1999. Chapter 6

Thompson and Turk, *Earth Science and the Environment*, 2nd edition, 1999. Chapters 42 and 21; Appendix B

PROCEDURES AND STRATEGIES

- The time necessary to complete this exercise can be controlled by the number of mineral specimens assigned for identification. We recommend that the minimum number include those minerals listed above.
- Several methods for presenting the specimens to be identified are possible. 1) Sets for every 2–4 students can be prepared and placed in trays or plastic containers (we recommend that the individual specimens be numbered so students can check their answers). 2) For those with a limited number of mineral samples, several sets of

specimens (each on a numbered card or in a numbered tray) can be placed about the lab.

- Special instructions on the use of a contact goniometer and dilute hydrochloric acid should be given prior to beginning the lab.
- Students often have difficulty with the properties of luster, cleavage, and specific gravity. Discussing and demonstrating these properties prior to beginning the lab is recommended.
- Students often wish to know if their identifications are correct. Therefore, if you have identified individual mineral specimens by numbering them or placing them on a numbered card, we recommend that you fill out a copy of the Mineral Identification Chart, Table 1.3, and post it after the laboratory session is over.
- In conclusion, throughout the lab period it should be stressed that the goal is to learn how to identify minerals and not simply to "put a name" on them.

ANSWERS TO EXERCISE ONE QUESTIONS

1. Minerals = quartz, emerald, and halite. All of the other items are not minerals.
2. Quartz = B; Galena = A; Limonite = C; Gypsum = D, Talc = E, Native copper = A
3. Answers will vary with the mineral specimens provided for identification.
4. Both fluorite and quartz exhibit a variety of colors.
5. Specimen A: color = red brown, streak = red brown; specimen B: color = dark gray / black, streak = red brown.
6. Answers will vary with the mineral specimens provided for testing streak.
7. Nonmetallic
8. A = fibrous habit B = bladed habit C = banded habit D = cubic crystals
9. a) The angles are about the same. b) In short, the angles between the crystal faces of a mineral will collectively determine the geometric shape of a sample (i.e., 90° angles in all three dimensions will produce a cubic geometric shape).
10. A = fluorite B = topaz
11. Answers will vary depending on the samples selected.
12. The sample exhibits one direction of cleavage (basal cleavage), which produces thin sheets when cleaved.

13. a) six planes of cleavage; b) three directions of cleavage; c) the cleavage directions meet at angles other than 90° (rhombohedral cleavage)

14.–16. Answers will vary depending on the samples selected or provided.

17. A, C, and D are feldspar; B is quartz

18. Answers will vary depending on the order of the minerals identified.

NOTE:

We recommend that the Mineral Data Sheet, Figure 1.19, be filled in and made available for students to verify their mineral identifications.

ANSWERS TO EXERCISE ONE SUMMARY/REPORT PAGE QUESTIONS

1. Cleavage; hardness; luster; streak; fracture

2. A cube or cubic cleavage

3. Muscovite = one direction (thin sheets); Calcite = rhombohedral (three directions not at 90°); Halite = cubic (three directions at 90°).

4. Feldspar minerals have two directions of cleavage at 90°, producing rectangular shapes.

5. Color

6. Muscovite; plagioclase feldspar; quartz; halite; quartz; quartz; galena

7. Crystals of fluorite = A; cleavage of fluorite = B

8. a) cubic crystals b) striations c) pyrite

9. Banded habit

10. Hardness = 3

11. Elastic

12. Olivine

13. Halite: cubic cleavage and salty taste

    Galena: cubic cleavage and metallic luster

    Magnetite: attracted to magnet, high specific gravity

    Muscovite: light color, basal cleavage

    Hematite: red-brown streak

Fluorite: octahedral cleavage

Talc: hardness of 1, “greasy” feel

Graphite: metallic luster, hardness of 1

Calcite: rhombohedral cleavage

14. Potassium feldspar and plagioclase feldspar

15. Galena = major ore of lead; hematite = ore of iron; graphite = pencil lead; sphalerite = major ore of zinc; gypsum = wallboard; calcite = cement

NOTES:

Exercise Two

Rocks and the Rock Cycle

MATERIALS REQUIRED

The following materials are necessary to complete this exercise and should be available in the laboratory. The quantities depend upon the number of students in the laboratory and whether or not students are to work independently or in groups.

igneous rocks	metric ruler
sedimentary rocks	glass plate
metamorphic rocks	iron nail
hand lens	dilute hydrochloric acid

Recommended igneous rock specimens: granite, diorite, gabbro, rhyolite, andesite, basalt, porphyritic basalt, obsidian, pumice, tuff

Recommended sedimentary rock specimens: conglomerate, breccia, sandstone, shale, coquina, fossiliferous limestone, chalk, dolostone, chert or flint, rock salt, bituminous coal

Recommended metamorphic rock specimens: slate, phyllite, schist, gneiss, marble, quartzite, anthracite coal

TEXTBOOK REFERENCES

Tarbuck and Lutgens, *Earth Science*, 12th edition, 2009. Chapter 3

Tarbuck and Lutgens, *Earth Science*, 11th edition, 2006. Chapter 3

Lutgens and Tarbuck, *Foundations of Earth Science*, 5th edition, 2008. Chapter 2

Murphy and Nance, *Earth Science Today*, 1999. Chapters 2 and 18

Skinner and Porter, *The Blue Planet*, 2nd edition, 1999. Chapters 6 and 18

Thompson and Turk, *Earth Science and the Environment*, 2nd edition, 1999. Chapter 3

PROCEDURES AND STRATEGIES

- The time required for completing this exercise can be controlled by the number of igneous, sedimentary, and metamorphic rock specimens to be identified.
- Student samples of igneous rocks, sedimentary rocks, and metamorphic rocks should be kept separate so that the different rock types can be compared. Two possible methods for presenting the student specimens are: 1)

place each rock type (preferably with each specimen numbered) in separate, labeled trays (or labeled plastic containers) so each group of 2–4 students has a complete set; or, 2) for those with a limited number of rock samples, place several separate sets of igneous, sedimentary, and metamorphic rocks on separate numbered cards or in separate numbered trays (i.e., I1, I2,...S1, S2,...M1, M2...) around the laboratory.

- Prior to beginning the laboratory session, a general review of the occurrence, characteristics, textures, and mineral compositions of the three rock types may be beneficial.
- Special instructions should be given on the use of dilute hydrochloric acid before beginning the exercise.
- To assist students in checking their identifications, we recommend that the classification charts for each rock type be filled in and posted after the laboratory session is over. Also, if possible, a set of identified and labeled rocks should be displayed in the laboratory.
- Throughout the laboratory session, it should stressed that the goal of the exercise is to learn how to describe and identify rocks and not to simply "put a name" on them.

ANSWERS TO EXERCISE TWO QUESTIONS

1. B, C, D, and G
2. B and G
3. C
4. B
5. A, F, and H
6. A and F
7. Igneous
8. E
9. H
10. Igneous = A and F Sedimentary = B, C, D, G, and H Metamorphic = E
11. B and G
12. Larger crystals are phenocrysts and the surrounding crystals are called groundmass.
13. A, B, and E
14. At great depth; slowly; intrusive

15. C and F

16. On the surface; rapidly; extrusive

17. D

18. H

19. The different appearances of samples A and C are the result of slow cooling of magma (A) vs. rapid cooling of lava (C).

20. Label a quartz crystal on sample A.

21. Label a feldspar crystal on sample B.

22. Quartz

23. a) A and F b) C and D c) B d) E

24. Answers will vary depending upon the samples supplied.

25. Shape of the particles—rounded (A) vs. angular (B)

26. I and J

27. Hardness

28. The fact that calcite reacts with diluted hydrochloric acid would aid in identification.

29. Both samples are composed of fossil fragments. However, in fossiliferous limestone, the fragments are cemented tightly together, while coquina is a less dense, loosely cemented aggregate of fragments.

30. Both are crystalline in appearance, but sample A is composed of at least two or more minerals whereas sample G is more uniform with only one mineral.

31. Both rocks are composed of microcrystalline quartz.

32. Nonclastic

33. The simplest test would be hardness—calcite is much softer than quart. You could also use diluted hydrochloric acid to test for calcite since quartz does not react with it.

34. Potassium feldspar

35. Answers will vary depending upon the samples supplied.

36. Rock gypsum = D; Conglomerate = G and possibly A; Sandstone = C, G, J, and L; Shale = H, J, and K; Bituminous coal = F; Travertine = B

37. Coral reefs are found in warm, shallow marine environments with clear water.

38. The rocks in Zion National Park formed in an ancient desert environment with well-sorted sands and large dunes.

39. Answers will vary depending upon the samples supplied.

ANSWERS TO EXERCISE TWO SUMMARY/REPORT PAGE QUESTIONS

1. A = sedimentary B = metamorphic C = igneous

2. Marble = limestone; Slate = shale; Phyllite = shale or slate; Gneiss = granite; Quartzite = sandstone; Anthracite = bituminous coal

3. Igneous = E, I, K, and M

   Sedimentary = B, D, F, H, J, N, and O

   Metamorphic = A, C, G, and L

4. Schist, gneiss, slate, phyllite (upper left to lower right). In order of increasing metamorphic grade = slate, phyllite, schist, and gneiss.

5. A = scoria; igneous B = schist, metamorphic C = granite; igneous

   D = obsidian, igneous E = gneiss, metamorphic F = shale, detrital sedimentary

   G = conglomerate, detrital sedimentary H = porphyritic granite, igneous

NOTES: