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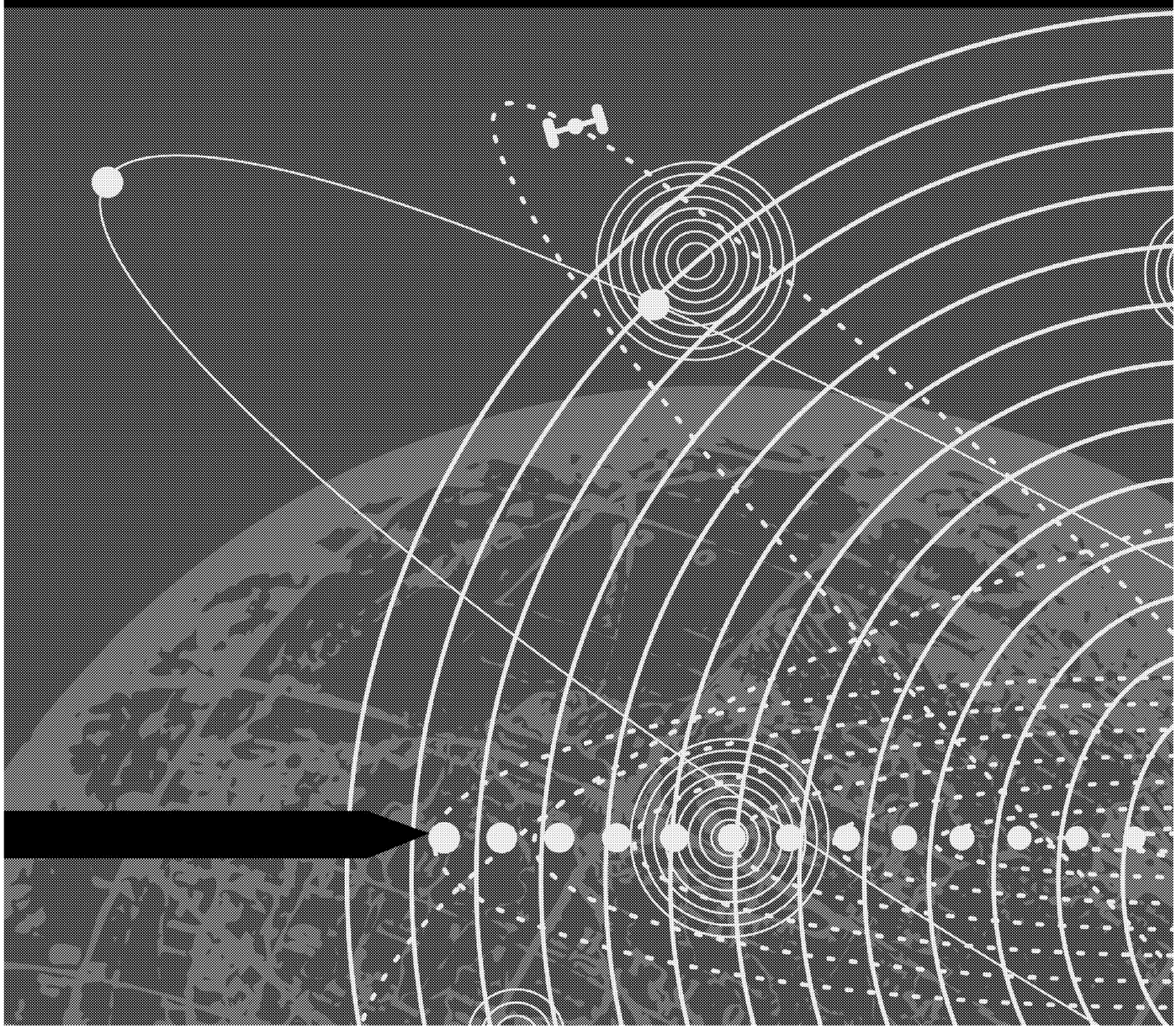


Gina Hamilton

Contents

Parent/Teacher/Student Guide

Dear Parents, Teachers, and Students,

Thank you for choosing the *Top Shelf Science* series to help you better understand some of the difficult ideas in high-school science. We are confident that our books will help students who have a greater knowledge of the subject matter being studied; they can also be used to provide a lab-based program for students learning at home.

Each volume of the *Top Shelf Science* series is designed for a particular course of study. Within each volume, concepts build sequentially, and it is recommended that students begin with the first section and move forward.

Each book has sections that are thematically designed. The laboratory exercises associated with each section are specific to a deeper understanding of the overlying concept. In Appendix II, you will find a list of materials that are necessary to conduct the lab exercises, as well as a list of science equipment dealers who may help you acquire things you need in the course of the lab exercise; we have tried to keep the materials list small, as well as provide lab lessons in which materials are readily accessible. Therefore, we have also provided alternatives, where possible, to the lab glassware and other large pieces of equipment that may not be located in your kitchen cabinet or small classroom.

In Appendix I, you will find answers to the questions in each unit, as well as a suggested grading rubric for essays and lab reports. Share these rubrics with students so that they can correct areas that need to be corrected before the next assignment. In keeping with the national science standards, we have also included a time line of the history of each discipline. Each volume also contains an index and a glossary.

Whether you are using our product as the basis for a home school experience, a new and fresh way of supporting textbook material, or as preparation for a college placement test, we are confident that *Top Shelf Science* can meet your needs.

Thank you!

The authors and editors of *Top Shelf Science*

BACKGROUND

Rocks and Minerals

Rocks are everywhere on the planet, from the bottom of the deepest part of the ocean to the tops of the highest mountains on Earth. These rocks are constantly forming, being destroyed, or changing. The entire crust of the earth, the outermost shell of the planet, is composed of rocks, which are, in turn, composed of one or more minerals.

Classification of Rocks

Rocks are classified by how they are formed.

Rocks are classified by how they are formed. There are three classifications of rocks: igneous, sedimentary, and metamorphic.

Igneous rocks are formed by the cooling and crystallization of hot, molten rock called magma, whose origin is in volcanoes and the spreading of the sea floor. The word igneous means "formed by fire." Igneous rock is very young rock, relatively recently formed, and it makes up about 95% of all rocks in Earth's crust. Basalt and granite, which are formed from cooled lava, are types of igneous rock. Obsidian, known as volcanic glass, is also igneous in origin.

Sedimentary rocks are formed when igneous rocks, or the remains of the hard shells and skeletons of living organisms, are weathered and carried by water, wind, or ice. These materials are known as **sediments**. The sandy or muddy material solidifies under pressure. Although there are more igneous rocks in the crust of the planet, most of the rocks we see at the surface are sedimentary. Sedimentary rocks include sandstone, limestone, and shale.

Metamorphic rocks are created when existing rocks are transformed by high temperature, enormous pressure, or both, without melting. The word metamorphic means "changed in form." If a rock melts and becomes magma, its new incarnation is igneous in origin. Marble, which was once limestone, and slate, which was once shale, are both examples of metamorphic rock.

All rocks are composed of minerals, which are naturally formed, inorganic crystalline structures composed of an orderly array of atoms, usually in a lattice arrangement. Most rocks contain the mineral group **silicates**, which are composed of silicon and oxygen

Minerals within rocks can be identified by physical properties, such as color, luster, cleavage, and streak.

compounds. Other groups include **oxides,** which are combinations of oxygen with some metal, such as iron. **Carbonates,** which are rocks formed from calcium and magnesium carbonate, are materials that once formed the hard body parts, shells and skeletons, of living organisms. **Sulfides** and **sulfates,** as the name implies, are formed from sulfur in conjunction with another mineral. Finally, some minerals, such as gold, copper, and iron, are composed of single elements.

Physical Properties of Minerals

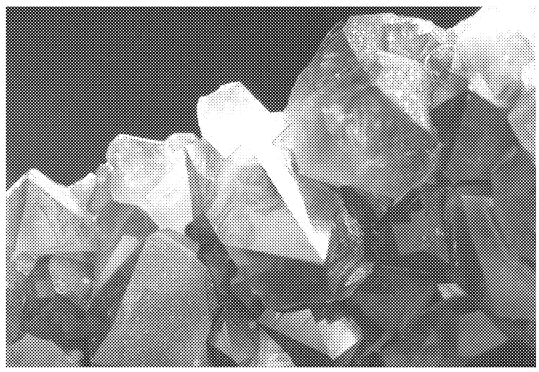
Minerals within rocks can be identified by physical properties, such as color, **luster** (the appearance of the surface of the mineral as it reflects light), **cleavage** (how the mineral behaves when it breaks), and **streak** (what sort of a mark a mineral leaves on a piece of rock when rubbed against it). Another physical property is **density.** The standard measure of density is **specific gravity,** which is the ratio of the weight of a certain volume of a substance to an equal volume of water. For instance, if 1 cubic centimeter of a given mineral weighs 3 times as much as an equal volume of water, its specific gravity is 3. These values can be looked up in mineral density tables to identify minerals.

Mineral	Scale Number
Diamond	10
Corundum	9
Topaz	8
Quartz	7
Feldspar	6
Apatite	5
Fluorite	4
Calcite	3
Gypsum	2
Talc	1

Another physical property of minerals is **hardness,** which can be defined as the resistance of a mineral to be scratched, or the ability of the mineral to scratch other minerals. The degrees of hardness are represented by **Mohs's scale of hardness.** A popular misconception about Mohs's scale is that it was named as an abbreviation for "measure of hardness scale." In fact, it was named for the scientist who developed the scale in 1822, Friedrich Mohs. The scale appears to the left.

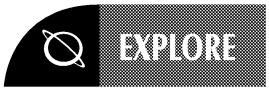
Under this scale, a diamond can scratch anything, whereas talc can scratch nothing. Similarly, a diamond cannot be scratched by anything except another diamond, while talc can be scratched by virtually any other material. A mineral's hardness depends on the strength of its chemical bonds. The larger the atoms involved in the bond, the "softer" the material is likely to be. The structure of the atomic arrangement is also important. Gold is softer than diamonds because the gold atom is larger than the carbon atom that makes up a

diamond; however, graphite, also composed of carbon, is much softer than a diamond because its molecular structure is loose, while the diamond's crystal form is extremely tight.



Amethyst crystal

Crystal structure, then, is another way to identify minerals. The crystal to the left is an amethyst, part of the quartz family of crystals. It is a member of the silicate group of minerals. The pentagonal shape of the main mass, forming a point at the top of the crystal, is common to quartzes. Other crystals form in cubes, in grape-like clusters, or in pointy fibers. Taken together with the rest of the physical properties of minerals, crystal structure gives us a good method to identify minerals within rocks. Crystals occasionally grow in geodes, hollow balls of rock that are left undisturbed for long periods of time.



Exploration Activities

Fill in the correct word in each of the sentences below, using this list: igneous, sedimentary, metamorphic, silicates, specific gravity, Mohs's scale of hardness, crystals.

1. Obsidian is a type of _____ rock.

2. A measure of density is _____.

3. Under _____, diamonds are the hardest minerals.

4. _____ rocks undergo change owing to temperature or pressure.

5. _____ comprise most of the minerals on Earth.

6. Limestone is a type of _____ rock.

7. _____ are characterized by an orderly arrangement of atoms, and a specific shape.

