Program Features

Frey's Inquiry Investigations™ *Earth's Resources* engages your students in active and meaningful learning. Each of the five units in the program focuses on a different theme and contains an exciting collection of classroom-tested activities that let students experience the wonders of science through direct, hands-on experience.

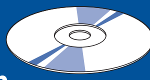
These standards-based units link to core science concepts, making them an excellent complement to your existing curriculum. Best of all, you won't need a strong background in science to use this program—the comprehensive Curriculum Guide that comes with the module provides teacher-friendly instructions on how to teach the activities.

Each Unit includes

- Comprehensive investigation literature with planning and preparation tips, step-by-step instructions, expected outcomes, cross-curricular integration, and assessment strategies.
- A reproducible Student Guide for each unit with complete background information, step-by-step procedures, data tables, analysis questions, and options for open-ended student-designed investigations that challenge students to use their critical thinking skills. Also included are related websites and *Read More About It* sources for students to obtain additional information.
- A collection of safe and fun inquiry-based lab investigations with real-world applications.
- Enough high-quality science materials for a class of up to 40 students working in groups.
- A handy Storage Center to neatly store all materials.

The Curriculum Guide includes

- Comprehensive, unit-specific teacher and student guides.
- Materials lists, a comprehensive Glossary, Useful Equivalents, Symbols, and Equations, Science Safety, and How to Record, Analyze, and Report Data.
- Comprehensive Inquiry Activity—Geology Dig



Also included with the Inquiry Investigations™ Module *Earth's Resources* is the Curriculum Resource CD-ROM*, which includes…

Content Tutorials:

- Topic-related content featuring detailed illustrations that cover key Earth science concepts.
- Hyper-linked glossary of key concepts and terms.

Assessment Monitoring:

- Test questions that can be accessed in either Practice or Test Mode; questions allow students to demonstrate content knowledge.
- Customized tests and worksheets with five question types (essay, multiple choice, concept map, matching, and labeling), as well as dynamic web-deliverable multi-media tutorials and presentations.

Correlation to National and State Science Standards:

- Key concepts correlated to the National Science Education Standards (NSES) and a link to the Frey Scientific website for selected State standards.

Teacher Resources:

- Image gallery containing printable illustrations and images relating to an Earth science topic area.
- Dynamic animations that reinforce key Earth science concepts.
- Experimental results section that provides useful teacher tips for each activity as well as in-depth experimental data analysis. Where applicable, graphs, tables, and images are provided to enhance each activity.

Virtual Laboratory—Mineral Identification

- Explore the object-based virtual lab environment. The virtual lab allows students to interactively perform every step of the lab activity by manipulating lab equipment on their virtual workbench.
- Use the electronic notebook to record and analyze results.

**System Requirements: Windows 2000 or higher, VISTA-compatible, Mac 9.2 or higher (including OSX), 128 MB RAM.*

The Curriculum Guide contains the following sections – Teacher Guide, Appendix, Student Resources, and a Curriculum Resource CD-ROM. Each section has the same general format, let's take a closer look –

A Closer Look at the Teacher Guide…

Science Concepts and Skills

- Overview of key concepts and skills presented in each lab

Science Standards

- A list of the National Science Education Standards covered in each lab

Materials

- Comprehensive list of the materials needed for each lab

Time Requirements

- Amount of time needed for preparation and activities

Safety and Disposal

- Tips for safe disposal of waste materials and student safety

Curriculum Resource CD-ROM

- Additional resources found on the Curriculum Resource CD-ROM

Pre-lab Preparation

- Overview of any necessary pre-lab preparation

Teacher Guide

Science Concepts and Skills

- Analytical thinking
- Making observations and inferences
- The rock cycle
- Sedimentary rock
- Metamorphic rock
- Igneous rock
- Magma
- Weathering
- Erosion
- Lithification
- Crystallization
- Uplifting

National Science Standards

Standard A – Science as Inquiry

A1	Identify questions that can be answered through scientific investigations
A3	Use appropriate tools and techniques to gather, analyze, and interpret data
A4	Develop descriptions, explanations, predictions, and models using evidence
A5	Think critically and logically to make relationships between evidence and explanations
A6	Recognize and analyze alternative explanations and predictions
A7	Communicate scientific procedures and explanations
A9	Understandings about scientific inquiry

Standard D – Earth and Space Science

D1	Structure of the earth system

Standard F – Science in Personal and Social Perspectives

Safety and Disposal

Instruct students to follow proper lab safety techniques. Have students wear protective gloves, goggles, and an apron while working with chemicals. Students should keep their hands away from their face and mouth. Have students wash their hands before leaving the laboratory.

Liquid materials may be flushed down the drain with copious amounts of water. Solid materials may be disposed of in the trash.

Curriculum Correlation

See the *Curriculum Resource CD-ROM* for a correlation to the National Science Education Standards (NSES). Visit the Frey Scientific website (**www.freyscientific.com/inquiryinvestigations**) for selected state correlations.

See the **Curriculum Resource CD-ROM** to…

- Prepare web deliverable content
- Create assessment questions
- Explore a virtual lab
- View content tutorials
- Learn about experimental results
- Link key science concepts to selected State and National Standards

Teacher Guide

Lab Materials List

5	Graduated cylinders, plastic, 250 mL
10	Magnifying lenses
5	Mineral collections, set of 15
5	*Mohs Hardness Scales*
10	Streak plates

Teacher-Provided Items

1	Balance, digital, readability 0.1 g
5	Glass, piece (optional)
5	Knife, steel (or other steel object)
1	Paper towel, roll
5	Pennies, copper
	Water

Time Requirements

Activity 1: Identifying Mineral Color	
Pre-lab Preparation:	N/A
Activity:	45 minutes
Activity 2: Mineral Luster	
Pre-lab Preparation:	N/A
Activity:	45 minutes
Activity 3: The Streak of a Mineral	
Pre-lab Preparation:	N/A
Activity:	45 minutes
Activity 4: Testing the Hardness of a Mineral	
Pre-lab Preparation:	N/A
Activity:	45 minutes
Activity 5: Cleavage and Fracture	
Pre-lab Preparation:	N/A
Activity:	45 minutes
Activity 6: Specific Gravity	
Pre-lab Preparation:	N/A
Activity:	45 minutes

Pre-lab Preparation

Activity 1
Enough materials are provided for a class of forty students working in five groups of eight. Divide your class into groups accordingly.

Activity 2
Enough materials are provided for a class of forty students working in five groups of eight. Divide your class into groups accordingly.

Activity 3
Enough materials are provided for a class of forty students working in five groups of eight. Divide your class into groups accordingly.

Activity 4
Enough materials are provided for a class of forty students working in five groups of eight. Divide your class into groups accordingly.

Activity 5
Enough materials are provided for a class of forty students working in five groups of eight. Divide your class into groups accordingly.

Activity 6
Enough materials are provided for a class of forty students working in five groups of eight. Divide your class into groups accordingly.

Unit 2 | Lab 3: Mineral Formation and Identification 47

A Closer Look at the Teacher Guide…

Objective

- Specific student goals of the activity

What you need

- Specific materials used in each activity

Safety and Disposal

- Important safety information specifically related to each activity

What to do

- Teacher friendly step-by-step procedures for each activity

Recording Observations

- Sample student data for each activity

Questions

- Questions to assess student understanding of the activity

Cross-Curricular Integration

- Suggestions of how to relate the key concepts of the lab to other disciplines

Extensions and Challenges

- Additional activity suggestions to reinforce the key concepts presented in the lab

Teacher Guide

ACTIVITY 1

The Rock Cycle

Objective

In this activity, students will identify the stages in the rock cycle. Students also examine rock samples to identify how they are formed and their physical properties.

What you need

Per Group

1 Magnifying lens
1 Rock sample, granite
1 Rock sample, limestone
1 Rock sample, marble
1 Rock sample, obsidian

Safety and Disposal

Instruct students to follow proper lab safety techniques. Students should keep their hands away from their face and mouth. Have students wash their hands before leaving the laboratory.

Liquid materials may be flushed down the drain with copious amounts of water. Solid materials may be disposed of in the trash.

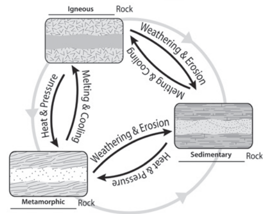
What to do

STEP 1

Have students read the *Background* section in the *Student Guide*.

STEP 2

Have students fill in the blanks on the illustration below with the appropriate rock type.



STEP 3

Have students examine the physical properties of each rock sample. Have students use a magnifying lens to get a closer look at the grain size and composition of each rock sample. Have students record their observations in Data Table #1 in the *Recording Observations* section.

STEP 4

Have stu… below to… *Recording*…

Weatheri… Transport… Uplift to… Melting… Magma… Erosion… Igneous r…

STEP 5

Have stu… Have stu… laborator… follow.

Teacher Guide

Extensions and Challenges

Have students investigate how geologists and archaeologists use fossils found in sedimentary rock to determine catastrophic events of the past.

Take a look in your own back yard or on the grounds of your school. Collect small samples of rock and have students determine how they were formed. Discuss possible reasons for the samples being exposed at the surface.

Have students develop an experiment to explore how different crystals form from the evaporation of various solutions. For example, have students mix up 10 % solutions of sodium bicarbonate, sodium chloride, and calcium chloride. Then, have students place 5 mL of … students … the solu… it over … have stu… icroscope

Cross-Curricular Integration

Chemistry

Have students investigate how to make crystals of various soluble salts such as halite, alum, copper sulfate, and iron sulfate. Have students study the different chemical formulas and the shapes of the crystals.

Physics

The interrelationship between heat and pressure as they act on different materials is an important aspect of engineering. When solid wax is heated, it changes from a solid to a liquid. Have students investigate the effects of heat and pressure on various materials like steel, concrete, and glass. Have students investigate how heat and pressure is used to turn one of the softest materials on Earth, carbon, into diamond – the hardest substance on Earth.

Environmental Science

The bottom of lakes and oceans are lined with rock. Over time, the chemical properties of water begin to break down the rocks and dissolve them into the water. Lakes are dependent on rocks to buffer the water and thereby reduce the acidification caused by acid rain. Have students examine how water quality in a lake and the organisms in the lake are affected by the type of rock dissolved into the water.

Archaeology

Rocks hold key information to our geologic and cultural past. Organize a visit to a local museum to investigate fossils and other artifacts found in sedimentary rock.

…riculum Resource CD-ROM to…
…cience concepts to …tate and National
…eb deliverable content …virtual lab

Unit 1 | Lab 1: The Rock Cycle 31

Teacher Guide

Recording Observations

Data Table #1

Setup	Evaporation Occurred	Prediction	Observations
A	Slowly	Crystals will form	Large crystals formed in addition to a layer of crust (salt)
B	Quickly	No crystals will form	No crystals formed, only a layer of crust (salt)

Note: *Individual results may vary.*

Questions

Use the following questions to assess student understanding of the concepts introduced in the activity.

1. **What is the material left on the bottom of each Petri plate?**
   Salt
2. **Are crystals visible in either Petri plate? Which one?**
   Yes, crystals are visible in Petri plate "A." No crystals are visible in Petri plate "B."
3. **What conclusion can you make about the relationship between the size of a mineral crystal and the amount of time it took to form?**
   When water has a longer time to evaporate, the crystals have a longer time to form and grow larger. When water evaporates quickly, crystals do not have a chance to grow or develop.
4. **How is this experiment similar to cooling magma in Earth's crust?**
   When magma cools quickly, no crystals form or the crystals are very small. This is similar to water evaporating quickly. When magma cools slowly, larger crystals develop and grow. This is similar to the water evaporating slowly.
5. **Which Petri plate setup simulates the formation of extrusive igneous rock? Explain your answer.**
   Petri plate "B" simulates the formation of extrusive igneous rock because the water evaporated quickly, and crystals did not form.
6. **Which Petri plate setup simulates the formation of intrusive igneous rock? Explain your answer.**
   Petri plate "A" simulates the formation of intrusive igneous rock because the water evaporated slowly, and crystals formed.
7. **Which, if any, of the following rocks do not have visible crystals; obsidian, granite, or marble?**
   Obsidian

See the **Curriculum Resource CD-ROM** to…
- Learn more about experimental results and useful teacher tips
- Enhance each activity by accessing graphs, tables, and images

See the **Curriculum Resource CD-ROM** to…
- Create more assessment questions
- Customize worksheets and tests with five question types (essay, multiple choice, concept map, matching, and labeling)

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A Closer Look at the Appendix…

Laboratory Notebook

- Useful tips on how to record, organize, and understand data

The Laboratory Notebook: Recording, Analyzing, and Reporting Data

Data sets are unbiased information gathered through the scientific process that can lead to knowledge and understanding. To be useful, data must be recorded, organized, graphed, analyzed, and reported.

Recording Data

Science deals with verifiable observations. All scientists must keep clear and accurate records of their observations. It is critical that these notebook recordings are made at the time of observation.

Recording data can be done manually through the reading of an instrument, such as a thermometer, and writing down measurements in a lab notebook or data book. Some data measurement probes and instruments (temperature, balance, pH, dissolved oxygen to name a few) can sample and transmit data to a computer for storage in a data table.

At times, your investigation may require the use of a video or photo camera to record visual information. Try to include some dimensional reference (a ruler or other feature) in your shots to provide the correct perspective. Digital photo cameras and scanners allow an investigator to capture experimental results.

Organizing Data

Make sure data sets are presented in tables listed in correct relation to each other. Sometimes your investigations may call for the collection of very large data sets. One way to manage this pile of data is through a database—a large, complex list of facts and information. A database can be a card file or an electronic program that can both recall and merge data. FileMaker Pro (by FileMaker, Inc) or Excel (by Microsoft) are powerful database programs that combine database management and desktop-to-Web network publishing

reproducibility of a result. For example, if you measure a quantity several times and the values agree closely with one another, your measurement is precise. Accuracy describes how close a measured value is to the true or known value. The closer a measured value is to the true value, the more accurate it is. Let's investigate this further.

For example, examine the data sets below.

Procedure 1:	20.1
	20.1
	20.2
	20.0
Procedure 2:	24.5
	25.6
	26.1
	25.1

If the true value is 25.3, then data collected from procedure 2 is more accurate but less precise than the data collected from procedure 1. In this case the precision is poor but the accuracy is good. An ideal procedure is both accurate and precise.

Data Books

The best method of record-keeping is to record observations in a laboratory notebook or data book. Ideally, this should be a stiff-covered book, permanently bound, not loose-leaf, preferably with square grid pages.

Keep records in a diary form, recording the date first. If you make observations for two or more investigations on the same day, use numbers or abbreviations of the titles as subheadings.

Data may be recorded as words. In the laboratory, time is short. Make notes as brief as possible—but to the point. You may choose to sketch your observations. Drawings, digital images, and digital video are all useful data recording techniques.

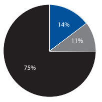
Graphing Data

- Examples of ways to graphically present data

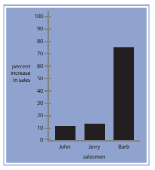
Graphing Data

When you make a graph, the first step is to determine which kind to create. What you want to show and the kind of data you have will determine which graph type is most useful:

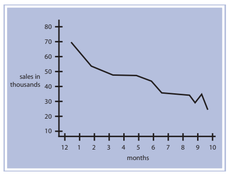
Circle graph – useful in showing parts or proportions of a whole.



Bar graph – useful for comparing quantities and changes over time.



Line graph – useful for comparing two sets of data or showing changes and trends over time.



Analyzing Data

When you analyze data you look for trends or patterns. You also look to see whether or not your data supports your reasoned guess—your hypothesis. If you have access to a computer, special analysis programs or spreadsheets (e.g., Microsoft Excel®) allow you to tabulate, manipulate (perform mathematical calculations), and graph your data.

Laboratory Reports

Discoveries become a part of science only if they are reported to others. In writing, scientists must express themselves clearly so that others can repeat their procedures exactly. Scientific reports usually follow the following form:

- **Title**
- **Introduction**: how the problem arose and a summary of past investigative work.
- **Materials and equipment**
- **Procedure**: complete and exact account of what was done in gathering the data.
- **Results**: data obtained from the procedure, often in the form of tables and graphs.
- **Discussion**: points out the relationship between the data and the purpose of the investigation.
- **Conclusion**: summary of the meaning of the results, often suggesting further work that might be done to clarify issues that the data may have uncovered.
- **References**: published scientific reports that have been specifically mentioned in the report.

Appendix | The Laboratory Notebook 139

Laboratory Reports

- General outline for scientific reports

A Closer Look at the Appendix…

Useful Equivalents, Symbols, and Equations

- Quick reference guide of common conversions, symbols, and equations

Useful Equivalents, Symbols, and Equations

Equivalents

Mass

1 kilogram (kg)	= 1,000 grams (g)
1 gram (g)	= 0.001 kg
1 milligram (mg)	= 0.001 g
1 microgram (µg)	= 0.000001 g

Liquid Volume

1 kiloliter (kL)	= 1,000 L
1 milliliter (mL)	= 0.001 L
1 mL	= 1 cm^3
1 microliter (µL)	= 0.000001 L

Length

1 kilometer (km)	= 1,000 m
1 centimeter (cm)	= 0.01 m
1 millimeter (mm)	= 0.001 m
1 micrometer (µm)	= 0.000001 m

Temperature

$T_{Fahrenheit} = (9/5 \times T_{Celsius}) + 32$

$T_{Celsius} = 5/9(T_{Fahrenheit} - 32)$

Common Symbols

Quantity	Common Symbol	SI Unit
Temperature	T	°C
Density	ρ	g/cm^3

Common Equations

Quantity	Formula
Density	= mass / volume
Specific gravity	= density of sample / density of water*

** density of water = 1 g/cm³*

Glossary

- Comprehensive glossary of key terms

Glossary

A

Abrasion Gradual wearing of small fragments of rock by windblown sand, moving water, or glacial ice.

Absolute dating Method of dating fossils that uses radioactive methods to determine the actual age of the rock in which a fossil is found.

Acid rain (Acid precipitation) The deposition of acidic components in rain, snow, fog, dew, or dry particles.

Adamantine luster Having the reflectance of a diamond.

Allochromatic minerals Minerals can have different colors depending on the impurities trapped within them or the way the crystal grew as the mineral developed.

Amber A hard translucent yellow, orange, or brownish-yellow fossil resin.

Asthenosphere Hot layer of Earth's upper mantle that flows very slowly.

B

Batholith The largest of the intrusive formations; typically consists of granite rock.

Bedrock Parent material on top of which soil develops over time.

C

Carbonic acid A weak acid formed when the carbon dioxide in air is dissolved in rain water; easily weathers marble and limestone.

Cast Type of fossil that forms when sediments fill the internal body cavity of an animal before the external skeleton decays, producing an internal impression of the skeleton.

Cementation Process by which minerals glue together loose sediments, forming sedimentary rock.

Chemical formula Concise way of expressing information about the atoms that constitute a particular chemical compound.

Chemical rock Sedimentary rock made from minerals that were once dissolved in water.

Chemical weathering Breaking down of rocks by changing the chemical composition of its minerals into different substances.

Clastic rock Sedimentary rock made from pieces of pre-existing rock that have been compacted and cemented together.

Cleavage Splitting of a mineral along smooth surfaces.

Climate Weathering pattern in a specific region over a long period of time.

Compaction Squeezing together of sediments, under pressure, to form rock.

Constructive force Geological process that builds up land; deposition.

Continent One of the seven largest land masses on Earth.

Continental drift Idea that continents move from one part of Earth to the other was first proposed in 1915 by Alfred Wegener. He called the giant continent Pangaea, which he believed split apart long ago to form today's continents.

Convection currents Cycling of flowing matter as it is heated and cooled; caused by density differences.

Convergent boundary Place where two continental plates collide.

Appendix | Glossary 151

A Closer Look at the Student Guide…

Objectives

- Key concepts and student goals for the lab

Background

- Science information related to the lab topic

What to do

- Step-by-step procedures for each activity

Student Guide

INQUIRY INVESTIGATIONS™ LAB

Name

Teacher

Date

Unit 1 | Lab 1

The Rock Cycle

Objectives

- Describe the processes involved in the rock cycle
- Identify physical properties of sedimentary, metamorphic, and igneous rock samples
- Model the processes involved in the formation of a sedimentary rock
- Examine effects of heat and pressure on rock layers
- Identify how cooling rates affect crystal formation

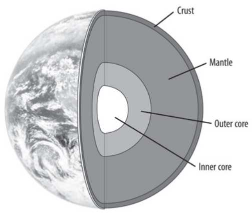
Safety and Disposal

Follow proper lab safety techniques as directed by your teacher. Wear protective gloves, goggles, and an apron while working with chemicals. Keep your hands away from your face and mouth. Wash your hands before leaving the laboratory.

Liquid materials may be flushed down the drain with copious amounts of water. Solid materials may be disposed of in the trash.

Background

At the turn of the 20th century, scientists determined that Earth is composed of three distinct layers—crust, mantle, and core. The core includes an inner core and an outer core.



The **crust**, or outermost layer, is rigid and thinner than the other two layers. The thickness of the crust varies from 6 km to 90 km. The crust is not one solid piece. It is composed of several large pieces, called plates, that can shift about. The movement of Earth's plates, called **plate tectonics**, causes the plates to bump together. The crust breaks, and an earthquake may result. Below the crust is the **mantle**, a dense, hot layer of semi-solid rock approximately 2,900 km thick. The mantle contains more iron, calcium, and magnesium than the crust. The mantle is also hotter and denser because temperature and pressure inside Earth increase with depth. At the center of Earth lies the **core**, which is nearly twice as dense as the mantle because its composition is metallic (iron-nickel alloy) rather than stony. The core is actually made of two distinct parts, an outer core and an inner core. The liquid outer core is 2,200 km thick. The solid inner core is 1,250 km thick. As Earth rotates, the liquid core spins and creates

Student Guide

The Rock Cycle

ACTIVITY 1

Objective

In this activity, you will identify the stages in the rock cycle. You will also examine rock samples to identify how they are formed and their physical properties.

What you need

Per Group

1	Magnifying lens
1	Rock sample, granite
1	Rock sample, limestone
1	Rock sample, marble
1	Rock sample, obsidian

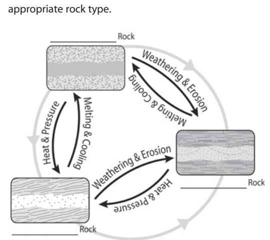
What to do

STEP 1

Read the *Background* section in the *Student Guide.*

STEP 2

Fill in the blanks on the illustration below with the appropriate rock type.



STEP 3

Examine the physical properties of each rock sample. Use a magnifying lens to get a closer look at the grain size and composition of each rock sample. Record your observations in Data Table #1 in the *Recording Observations* section.

STEP 4

Use the terms from the word bank below to fill in the rock cycle illustration located in the *Recording Observations* section.

Word Bank

Weathering	Igneous rock (extrusive)
Transportation	Crystallization
Uplift to surface	Sedimentary rock
Melting	Sedimentation
Magma	Compaction
Erosion	Metamorphic rock
Igneous rock (intrusive)	Heating / squishing

STEP 5

Clean up your work area as directed by your teacher. Wash your hands before leaving the laboratory. Answer the questions that follow.

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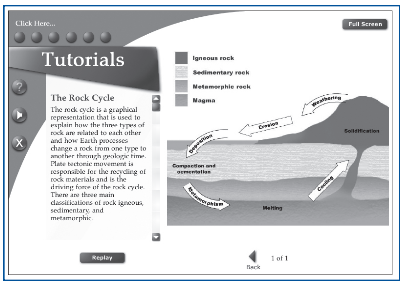
A Closer Look at the Curriculum Resource CD-ROM*…

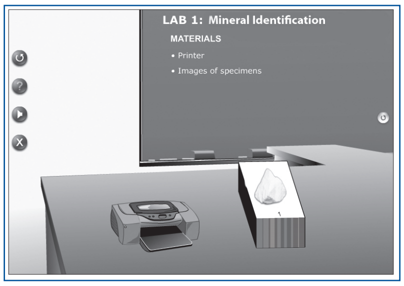


Content Tutorials

- Comprehensive tutorials offering self-paced, individualized lessons through illustrations and animations
- Hyper-linked glossary of key concepts and terms

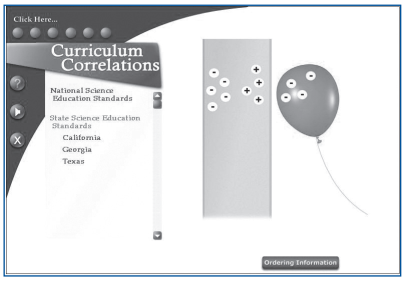
Assessment Monitoring

- Access test questions in either Practice or Test Mode to provide students with exam experience
- Create customized tests and worksheets with various question types, as well as dynamic multimedia tutorials and presentations—saving them on a disk or in web-ready format for easy Internet access



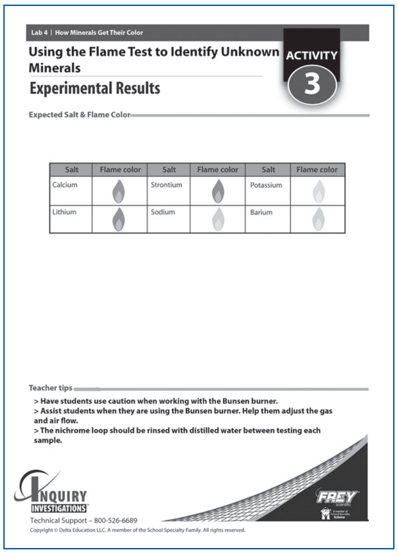
Virtual Laboratory

- Explore the object-based virtual lab environment. The virtual lab allows students to interactively perform every step of a lab activity by manipulating lab equipment on their virtual lab workbench.
- The electronic notebook allows students to record and analyze data.



Correlations to National and selected State Standards

- Key concepts correlated to the National Science Education Standards and 25 selected State standards linked to the Frey Scientific website (**www.freyscientific.com/inquiryinvestigations**)



Lab 4 | How Minerals Get Their Color

Using the Flame Test to Identify Unknown Minerals

ACTIVITY 3

Experimental Results

Expected Salt & Flame Color

Salt	Flame color	Salt	Flame color	Salt	Flame color
Calcium		Strontium		Potassium	
Lithium		Sodium		Barium	

Teacher tips

> Have students use caution when working with the Bunsen burner.
> Assist students when they are using the Bunsen burner. Help them adjust the gas and air flow.
> The nichrome loop should be rinsed with distilled water between testing each sample.

INQUIRY INVESTIGATIONS

Technical Support – 800-526-6689

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Experimental Results

- Useful teacher tips for each activity, as well as in-depth experimental data analysis
- Graphs, tables, and images are provided to enhance each activity.

*CD-ROM System Requirements: Windows 2000 or higher, VISTA-compatible, Mac 9.2 or higher (including OSX), 128 MB RAM