

**Minerals and Mining**  
**Their Importance to Arizona**  
**A Multidisciplinary Unit**  
**for**  
**Grades 4-6**



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**by**  
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**Arizona Mining Association**  
**Arizona's Mines . . . Investing in Arizona's Minds**

## **Thank You**

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# **Minerals and Mining Their Importance to Arizona**

## **Intermediate Level (Grades 4-6)**

### **Rationale**

Almost all youngsters are interested in and curious about rocks and minerals. Apart from their beauty, and their usefulness, they might intrigue children because they are tactile and easily accessible.

The study of rocks, minerals, copper, and copper mining in Arizona is natural in grades 4-6. Through this unit Arizona Academic Content Standards in science, and social studies are addressed with applications in language arts, technology, and work place skills. In addition art and music are also used in learning experiences and assessments.

Enduring understandings about the physical world, our dependence on mineral resources in our modern society, as well as the nature of economics and its impact on our lives are emphasized throughout the unit.

The unit is designed to be used with 4<sup>th</sup> through 6<sup>th</sup> grade students and is easily adaptable to fit the educational level and expertise in each grade.

The unit and cumulative assessment could last from 5-8 weeks depending on the grade level and depth of the study. It should fall into the school year at a logical spot in the curriculum according the teaching and learning of the Arizona Academic Content Standards.

Prior to working on this unit, students will have worked in groups, pairs, and alone to produce products and presentations, both written and oral. They should be familiar with checklists and rubrics in general and with the six-trait writing rubric in some form. They will have had practice in making a magazine or studying the components of and producing parts of a magazine either in a language arts, social studies, or science unit. The debate suggested for this unit should be very loosely constructed for younger students or students who have had no formal work with debates or panel discussions.

Although this unit allows teachers to introduce strategies for learning and demonstrating learning, no assignment should be treated as an assessment unless students are very familiar with the components of and methods used to comfortably produce a high-quality product or presentation.

### **Structure for Performance-based Units of Study**

This rock and mineral unit of study was developed using a performance-based teaching, learning, and assessment model. This model requires that in order to achieve optimum performance with students, a teacher must “begin with the end in mind”. In other words instruction and assessment must both be carefully, strategically, and deliberately planned prior to instead of coincidental to engaging students in a set of learning experiences.

Following is the step-by-step process used to develop the unit:

1. Select a topic for study based on district curriculum, Arizona Academic Standards, District Standards, National Standards, and general interest.
2. Consider what students should know and be able to do as a result of their learning.
3. Write rationale for the unit including the purpose, timeframe, grade range, context, and curricular areas included.
4. Write learner outcomes and performance indicators. (Learner outcomes are those things students will know and be able to do as a result of their learning. Performance indicators are the things that must be taught and that students must learn to achieve the learner outcomes.)
5. Delineate the main themes for the unit (enduring understandings) that students must assimilate as a result of their work.
6. Correlate the learner outcomes to grade range and topic specific Arizona Academic and District and National Standards.
7. Develop or select appropriate assessment opportunities that will measure understanding of the learner outcomes. (These may be cumulative for all of the performance outcomes, or they may address some or even just one of the outcomes.)
8. Flesh out procedures for assessments (written, oral, or both; group or individual product or performance; visuals or not; components; needed materials; time allotment, etc.).
9. Correlate assessment procedure and desired performance or product to Arizona Academic and District and National Standards (topic specific and procedure specific).
10. Write scoring criteria or rubric (holistic or analytic) for the assessment.
11. Devise an evaluation scheme for the assessment (self, peer, teacher, or a combination of these).
12. Select and develop learning experiences aligned to the assessments and the learner outcomes, performance indicators, and enduring understandings.
13. Correlate learning experiences to topic specific and procedure specific Arizona Academic, and District and National Standards.
14. Write scoring criteria and rubrics as necessary for the learning experiences.
15. Devise an evaluation scheme for the learning activities.
16. Select or develop extension and remediation opportunities for assessment and learning experiences, correlate them to standards, develop scoring criteria, and devise evaluation schemes for them.
17. Provide a list of resources (teacher and student) and reference tools used in the writing of and to be used in the implementation of the unit.

The flow of the development of the unit can be summarized as follows:

**Topic → Rationale → Learner Outcomes and Performance Indicators → Enduring Understandings → Standards Correlations to Learner Outcomes and Performance Indicators → Assessment Opportunities → Standards Correlations to Assessments (Topic Specific and Procedure Specific) → Assessment Scoring Criteria and Rubrics → Evaluation Method(s) → Learning Experiences → Correlation of Learning Experiences to Standards (Topic Specific and Procedure Specific) → Scoring Criteria and Rubrics for Learning Experiences → Evaluation Method(s) → Alternative Assessments and Learning Experiences for Extension and Remediation, Correlation to Standards, Scoring Criteria and Rubrics, and Evaluation Method(s) → References and Resources for the Unit**

### **A Note about Rubrics and Scoring Criteria**

A rubric or other scoring criteria should be used for more than merely a scoring tool. Using a rubric or scoring criteria prior to and during instruction, students are able to see the expectations for their performance and thus produce quality work. *However, students should not be expected to interpret a rubric or scoring criteria without assistance.* The teacher must devote time to discussion to clarify terms and with the students come to a common understanding of the expectations outlined on the rubric or scoring criteria.

Many times teachers think that this is “giving away” the answers. However, it is more like allowing students to “work with a net” rather than without one. It is up to the student to produce quality and does not diminish their learning; rather it raises expectations for that quality and allows them to strive for and achieve excellence.

## For the Teacher

Before asking students to learn about rocks, minerals, copper, the copper mining industry, and uses of minerals (specifically copper) it is best that the teacher has fundamental understanding in these areas. A teacher can gain a good part of that understanding through workshops and academies offered by the Arizona Mining Association and by reading his or her own textbooks. However, there are additional books that can be useful so that the studies in this unit will afford all participants enduring understanding of Arizona's unique and fascinating place in our world. Among these materials are

*Copper the Mighty Metal*, by Gail Lichtenhan

*From the Ground Up*, by Jack Williams

*Historic Atlas of Arizona*, by Henry P. Walker and Don Bufkin

*The History of Mining in Arizona, vols. 1-3*, by Michael Canty and Michael Greely

*Metal Mining and the Environment*, distributed by the American Geological Institute

*The Mission, Means, and Memories of Arizona Miners*, by James McBride, Ph.D.

*Out of the Rock*, distributed by the National Energy Foundation (pp. 11-142)

*Roadside Geology of Arizona*, by Halka Chronic (pp. xii-xiv, 1-39)

*A World of Metals*, by W. Gordon Jeffery, Ph.D., P.Eng.

(All of these resources (except for *The History of Mining in Arizona, vols. 1-3*) are available from the Arizona Mining Association.)

## **Student Learner Outcomes, Performance Indicators, and Enduring Understandings**

### ***Enduring Understandings***

*Using technology and a scientific understanding of the properties of various resources (such as minerals), useful products can be manufactured.*

*Exploration for and mining of copper has and will continue to impact society in many ways.*

*In a free market system there are not enough resources to satisfy all the desires of all people, so there has to be some way of deciding who gets what.*

*The modern theory of plate tectonics, which serves as a unifying principle in geology, provides an explanation for the large and diverse array of phenomena related to the earth's surface.*

*Some minerals are very rare, and some exist in great quantities; but for practical purposes the ability to recover them is just as important as their abundance. As minerals are depleted, obtaining them becomes more difficult. Recycling and the development of substitutes can reduce the rate of depletion but may also be costly.*

## *Student Learner Outcomes and Performance Indicators*

### **Outcomes 1-3**

#### **A. Copper Mining’s Role in Arizona — Past, Present, and Future**

As a result of their work in this unit, students will

(Learner Outcome) *understand the important role of copper mining in Arizona by*

(Performance Indicators) investigating relevant people, places, and events in the state’s past;  
describing the current status of copper mining operations and their impact on the state’s economy; and  
predicting or projecting the future of Arizona’s copper industry.

<i>Performance Indicators</i>	<i>Standards Correlations for Outcome One</i>
investigating relevant people, places, and events in the state’s past	1SS-E1, PO 1-4 1SS-E3, PO 2-4 1SS-E4, PO 3-4 1SS-E5, PO 2
describing the current status of copper mining operations and their impact on the state’s economy	3SS-E2, PO 1-4
predicting or projecting the future of Arizona’s copper industry	4SS-E2, PO1 4SS-E3, PO1

#### **B. Copper as a Mineral and a Commodity**

As a result of their work in this unit, students will

(Learner Outcome) *describe the formation of copper and where it is found in the earth by*

(Performance Indicators) outlining the concept of plate tectonics;  
tracing the development of igneous, sedimentary, and metamorphic rocks; and  
distinguishing among atoms, elements, crystals, minerals, and rocks.

<i>Performance Indicators</i>	<i>Standards Correlations for Outcome Two</i>
outlining the concept of plate tectonics	6SC-E5, PO1
tracing the development of igneous, sedimentary, and metamorphic rocks	5SC-E1, PO1-3 6SC-E3, PO1-2
distinguishing among atoms, elements, crystals, minerals, and rocks	5SC-E1, PO1-3

(Learner Outcome) *Examine the connections between copper's important properties and as a commodity by*

(Performance Indicator) defining the following terms: *properties, commodity, economics* and *supply* and *demand*;  
 identifying and illustrating specific properties of copper;  
 developing the major categories of copper uses;  
 identifying specific uses of copper within developed categories; and  
 evaluating the importance of mineral resources in our lives using copper as a reference point.

<b><i>Performance Indicators</i></b>	<b><i>Standards Correlations for Outcome Three</i></b>
defining the following terms: <i>properties, commodity, economics</i> and <i>supply</i> and <i>demand</i>	4 SS-E2, PO 1 4SS-E3, PO1 5SS-E1. PO 1-3
identifying and illustrating specific properties of copper	5SS-E1, PO 1-3
developing the major categories of copper uses	4SS-E2, PO 1

## **Correlated Standards**

### **SCIENCE**

5SC-E1. Examine, describe, compare, measure, and classify objects and mixtures of substances based on common physical and chemical properties (e.g. states of matter, mass, volume, electrical charge, density, boiling points, pH, magnetism, solubility)

PO 1. Identify common physical and chemical properties

PO 2. Compare physical and chemical properties of common objects

PO 3. Compare physical and chemical properties of common mixtures

6SC-E3. Describe the composition (including the formation of minerals, rocks, and soil) and the structure of the earth

PO 1. Describe the layers of the earth and their compositions

PO 2. Explain how rocks, minerals, and soil are formed

6SC-E5. Explain how earth processes seen today, including erosion, movement of lithospheric plates, and changes in atmospheric composition, are similar to those that occurred in the past

PO 1. Identify earth processes

### **SOCIAL STUDIES**

1SS-E1. Understand and apply the basic tools of historical research, including chronology and how to collect, interpret, and employ information from historical materials.

PO 1. Place key events on a timeline and apply chronological terms correctly, including B. C. E. (B.C.), C.E. (A.D.), decade, century, generation

PO 2. Identify primary and secondary sources historians use to construct an understanding of the past, using such sources as letters, diaries, newspaper articles, archaeological evidence, maps, and government records

PO 4. Distinguish fact from fiction in historical novels and movies

1SS-E3. Describe Spanish and Mexican colonization and economic, social, and political interactions with the first inhabitants of Arizona, with emphasis on:

PO 2. the reasons for the early Spanish explorations, including those of Fray Marcos de Niza, Estevan, and Francisco Vásquez de Coronado

PO 3. the reasons for Spanish colonization, including the establishment of missions, presidios, and towns and impact on native inhabitants

PO 4. the contributions of Father Kino

1SS-E4. Describe the economic, social, and political life in the Arizona Territory and the legacy of various cultural groups to modern Arizona with emphasis on:

PO 3. the lives and contributions of various cultural and ethnic groups, including American Indians, Hispanics, and newcomers from the United States and other parts of the world

PO 4. the importance and contributions of various occupations to the growing Arizona communities, including soldiers (Buffalo soldiers), miners, merchants, freighters, homemakers, ranchers, cowboys, farmers, and railroad workers

1SS-E5. Describe the causes, course, and consequences of early European exploration of North America, with emphasis on:

PO 2. the characteristics and results of various European expeditions, including those of Christopher Columbus, John Cabot, Hernando Cortés, and Hernando de Soto

3SS-E2. Describe the impact of interactions between people and the natural environment on the development of places and regions in Arizona, including how people have adapted to and modified the environment with emphasis on:

PO 1. the reasons for migration to, and the settlement and growth of Phoenix, Mesa, Tucson, Flagstaff, Prescott, and Yuma including mining, ranching, agriculture, and tourism

PO 2. how places are connected by movement of people, goods, and ideas including the connection of Mexico to Arizona

PO 3. routes to and through the Arizona territory including the Gila Trail

PO 4. how people have depended on the physical environment and its natural resources to satisfy their basic needs including the consequences of Arizonan's adaptation to and modification of the natural environment

4SS-E2. Describe the functions of the major institutions in the United States economy, with emphasis on:

PO 1. the private business function in producing goods and services

4SS-E3. Describe how consumers and businesses interact in the United States economy with emphasis on:

PO 1. how competition, markets, and prices influence peoples' behavior

**READING**

R-E1. Use structural analysis skills such as identifying root words, prefixes, suffixes, and word origins to decode words unfamiliar in print

PO 1. Identify root words

PO 2. Infer meanings of words in a selection through knowledge of prefixes and suffixes

PO 3. Confirm meaning of words using context clues

R-E2. Use reading strategies such as making inferences and predictions, summarizing, paraphrasing, differentiating fact from opinion, drawing conclusions, and determining the author's purpose and perspective to comprehend written selections

PO 1. Identify the main ideas, critical and supporting details, and the author's purpose, feelings, and point of view of the text

PO 2. Distinguish fact from opinion

PO 3. Summarize the text in own words

PO 4. Compare and contrast the text (e.g. characters, genre, cultural differences, fact, fiction)

PO 5. Determine cause-and-effect relationships

PO 6. Identify the text in chronological order, sequential or logical order

PO 7. Make an inference using contextual clues

**WRITING**

W-E1. Use correct spelling, punctuation, capitalization, grammar and usage, along with varied sentence structure and paragraph organization, to complete effectively a variety of writing tasks

PO 1. Spell correctly

PO 2. Punctuate correctly (e.g., sentence endings, commas in a friendly letter's greeting and closing, commas in a series, abbreviations, quotations in dialog, apostrophes)

PO 3. Apply rules of capitalization (e.g., sentence beginnings, titles, abbreviations, proper nouns)

PO 4. Apply standard grammar and usage (e.g., subject-verb agreement, simple and compound sentences, appropriate verb tense, plurals)

PO 5. Organize paragraphs with a variety of sentence structures (e.g., simple, compound)

W-E3. Write a summary that presents information clearly and accurately, contains the most significant details, and preserves the position of the author

W-E4. Write an expository essay that contains effective introductory and summary statements and fully develops the ideas with details, facts, examples, and descriptions

W-E5. Write a report that conveys a point of view and develops a topic with appropriate facts, details, examples, and descriptions from a variety of cited sources

PO 1. Write a report in own words that states, develops, and provides a concluding statement for a point of view (perspective) about a topic that is narrow enough to be adequately covered

PO 2. Use logical sequence (including transitional words and phrases such as *first, next, then*)

PO 3. Provide support through facts, details, examples or descriptions that are appropriate, directly related to the topic, and from a variety of cited sources

W-E6. Write formal communications, such as personal or business letters, messages, directions and applications, in an appropriate format and for a specific audience and purpose

PO 1. Write a formal communication in an appropriate format for a specific audience and purpose

PO 2. Organize ideas in a meaningful sequence using transitional words or phrases (e.g., *first, next, then*)

PO 3. Express ideas that are clear and directly related to the topic

W-E8. Demonstrate research skills using reference materials such as a dictionary, encyclopedia and thesaurus to complete effectively a variety of writing tasks

PO 1. Implement a research strategy that includes

- selecting appropriate source for a specific research purpose
- utilizing reference materials (e.g., dictionary, thesaurus, encyclopedia, informational trade books, multimedia sources, Internet)
- writing a paraphrase of information from a source
- recording relevant information (e.g., notes, graphs, tables) taken from a research source
- organizing notes and integrating notes into a finished product
- incorporating notes into a finished product

**LISTENING AND SPEAKING**

- ♦ Prepare and deliver an organized speech and effectively convey the message through verbal and nonverbal communications with a specific audience
- ♦ Prepare and deliver an oral report in a content area and effectively convey the information through verbal and nonverbal communications with a specific audience
- ♦ Predict, clarify, analyze, and critique a speaker's information and point of view

**VIEWING AND PRESENTING**

- ♦ Analyze visual media for language, subject matter, and visual techniques used to influence opinions, decision making, and cultural perceptions
- ♦ Plan, develop, and produce a visual presentation using a variety of media such as videos, films, newspapers, magazines, and computer images
- ♦ Compare, contrast, and establish criteria to evaluate visual media for purpose and effectiveness

**TECHNOLOGY**

3T-E1. Use formatting capabilities of technology tools for communicating and illustrating

PO 1. Use word processing editing tools to revise a document (e.g., cut and paste, tabs and margins, font size, font style, delete and undo, selecting, spell check, click and drag)

PO 2. Design a word processing document with graphical elements (e.g., clip art, digital photographs, symbols, using text wrap, cropping, sizing, drawing tools)

3T-E2. Use a variety of technology tools for data collection and analysis

PO 2. Create and use a spreadsheet to analyze data (e.g., use formulas, create charts and graphs)

3T-E3. Publish and present information using technology tools

PO 1. Design and create a multimedia presentation of Web page using multiple digital sources (e.g., from camera, video, scanner, CD-ROM, Internet)

PO 2. Publish or present the above presentation

4T-E2. Use technology tools for individual and collaborative writing, communication and publishing activities to create curricular related products for audiences inside and outside the classroom

PO 1. Plan, design, and present an academic product using technology tools (e.g., multimedia authoring, presentation software, digital cameras, scanners, projection devices)

5T-E1. Locate information from electronic resources

PO 1. Identify electronic research resources

PO 2. Define subject searching and devise a search strategy to locate information using available electronic research resources (i.e., electronic card catalog, online or CD-ROM reference sources, grade level appropriate Internet resources)

PO 5. Identify the author, copyright date and publisher of information located in electronic resources, including Internet resources

## Cumulative Assessment Opportunity (Addresses All Learner Outcomes and Enduring Understandings)

### Magazine

<b>Standards Addressed</b>	
<b>SOCIAL STUDIES</b> 1SS-E1, PO 1,2,4 1SS-E3, PO 2-4 1SS-E4, PO 3-4 1SS-E5, PO 2 3SS-E2, PO 1-4 4SS-E2, PO 1 4SS-E3, PO 1	<b>LANGUAGE ARTS — READING</b> R-E1, PO 1-3 R-E2, PO 1-7  <b>LANGUAGE ARTS — WRITING</b> W-E1, PO 1-5 W-E3 W-E4 W-E5, PO 1-3 W-E6, PO 1-3 W-E8, PO 1
<b>TECHNOLOGY</b> 3T-E1, PO 1-2 3T-E2, PO 2 3T-E3, PO 1-2 4T-E2, PO 1 5T-E1, PO 1,2,5	<b>LANGUAGE ARTS — VIEWING AND PRESENTING</b> BULLETS 1-3
<b>SCIENCE</b> 5SC-E1, PO 1-3 6SC-E3, PO 1-2 6SC-E5, PO 1	

**Time Frame:** Up to 2 Weeks

**Materials Needed:** Paper  
 Writing Implements  
 Notes  
 Reference Materials  
 Computer for Word Processing (Optional)  
 Internet, (Optional)  
 Rubric for Copper Magazine (pp. 12-13)  
 Six-trait Writing Rubric (pp. 59-62)

**Procedure:** Divide the class into groups of 3 to 4 people.  
 Discuss the rubric and contents and elements of the magazine.  
 Have students work in groups of three to four people using the rubric, available resources, and what they have learned to produce a hard copy or electronic magazine that reflects their understanding of copper, copper mining, rocks and mineral resources, and earth's processes.  
 Upon their completion of the magazines, allow students to self-evaluate their work, giving evidence to justify their evaluation.  
 Have groups exchange magazines and evaluate each other's work giving evidence to justify their evaluations.

**Magazine Contents:** Historical Connections of People, Places, and Events in Arizona's Past with Copper Mining  
 Current Status of Copper Industry and Economic Impact  
 Future of Arizona's Copper Industry  
 Plate Tectonics  
 Rock Cycle  
 Rock Types  
 Atoms, Elements, Crystals, Minerals, Rocks  
 Formation of Copper  
 Copper's Properties and Uses

*Using technology and a scientific understanding of the properties of various resources (such as minerals), useful products can be manufactured.*

*Exploration for and mining of copper has and will continue to impact society in many ways.*

*In a free market system there are not enough resources to satisfy all the desires of all people, so there has to be some way of deciding who gets what.*

*The modern theory of plate tectonics, which serves as a unifying principle in geology, provides an explanation for the large and diverse array of phenomena related to the earth's surface.*

*Some minerals are very rare, and some exist in great quantities; but for practical purposes the ability to recover them is just as important as their abundance. As minerals are depleted, obtaining them becomes more difficult. Recycling and the development of substitutes can reduce the rate of depletion but may also be costly.*

**Magazine Elements:** Table of Contents  
 Articles  
 Editorials about Enduring Understandings  
 Captioned Pictures and Illustrations  
 Chart, Graph, or Timeline  
 Advertisements  
 Cover

## Rubric for Copper Magazine

Components of Magazine	<i>Levels of Quality</i>				
	<i>Excellent = 5</i>	<i>Very Good = 4</i>	<i>Adequate = 3</i>	<i>Poor = 2</i>	<i>Unacceptable as Presented = 1</i>
<b>Concepts</b>	<p>The magazine has all of the required concepts; they are presented thoroughly and accurately</p> <ul style="list-style-type: none"> <li>• Historical Connections of People, Places, Events, in Arizona's Past with Copper Mining</li> <li>• Current Status of the Copper Industry and Its Economic Impact</li> <li>• Future of Arizona's Copper Industry</li> <li>• Plate Tectonics</li> <li>• Rock Cycle</li> <li>• Rock Types</li> <li>• Atoms, Elements, Crystals, Minerals, Rocks</li> <li>• Formation of Copper</li> <li>• Copper's Properties and Uses</li> <li>• Enduring Understandings</li> </ul>	<p>The magazine has all of the required concepts; there are few to no errors of accuracy; any errors do not impact the overall effect of the magazine</p> <ul style="list-style-type: none"> <li>• Historical Connections of People, Places, Events, in Arizona's Past with Copper Mining</li> <li>• Current Status of the Copper Industry and its Economic Impact</li> <li>• Future of Arizona's Copper Industry</li> <li>• Plate Tectonics</li> <li>• Rock Cycle</li> <li>• Rock Types</li> <li>• Atoms, Elements, Crystals, Minerals, Rocks</li> <li>• Formation of Copper</li> <li>• Copper's Properties and Uses</li> <li>• Enduring Understandings</li> </ul>	<p>The magazine has all of the required concepts; errors of accuracy have a minor impact on the overall effect of the magazine</p> <ul style="list-style-type: none"> <li>• Historical Connections of People, Places, Events, in Arizona's Past with Copper Mining</li> <li>• Current Status of the Copper Industry and its Economic Impact</li> <li>• Future of Arizona's Copper Industry</li> <li>• Plate Tectonics</li> <li>• Rock Cycle</li> <li>• Rock Types</li> <li>• Atoms, Elements, Crystals, Minerals, Rocks</li> <li>• Formation of Copper</li> <li>• Copper's Properties and Uses</li> <li>• Enduring Understandings</li> </ul>	<p>The magazine has the majority of the required concepts, but there are major errors in accuracy of important information</p> <ul style="list-style-type: none"> <li>• Historical Connections of People, Places, Events, in Arizona's Past with Copper Mining</li> <li>• Current Status of the Copper Industry and its Economic Impact</li> <li>• Future of Arizona's Copper Industry</li> <li>• Plate Tectonics</li> <li>• Rock Cycle</li> <li>• Rock Types</li> <li>• Atoms, Elements, Crystals, Minerals, Rocks</li> <li>• Formation of Copper</li> <li>• Copper's Properties and Uses</li> <li>• Enduring Understandings</li> </ul>	<p>The magazine does not have the required concepts, and there are numerous errors in important information</p> <ul style="list-style-type: none"> <li>• Historical Connections of People, Places, Events, in Arizona's Past with Copper Mining</li> <li>• Current Status of the Copper Industry and its Economic Impact</li> <li>• Future of Arizona's Copper Industry</li> <li>• Plate Tectonics</li> <li>• Rock Cycle</li> <li>• Rock Types</li> <li>• Atoms, Elements, Crystals, Minerals, Rocks</li> <li>• Formation of Copper</li> <li>• Copper's Properties and Uses</li> <li>• Enduring Understandings</li> </ul>

## Rubric for Copper Magazine (continued)

Component s of Magazine	<i>Levels of Quality</i>				
	<i>Excellent = 5</i>	<i>Very Good = 4</i>	<i>Adequate = 3</i>	<i>Poor = 2</i>	<i>Unacceptable as Presented = 1</i>
<b>Magazine Elements</b>	<p>The magazine creatively and interestingly puts together the concepts using all of the required elements</p> <ul style="list-style-type: none"> <li>• Table of Contents</li> <li>• Articles</li> <li>• Captioned Pictures/Illustrations</li> <li>• Chart, Graph, or Timeline</li> <li>• Advertisements</li> <li>• Cover</li> </ul>	<p>The magazine puts together the concepts using all of the required elements, but, it does not have the creativity of an excellent product</p> <ul style="list-style-type: none"> <li>• Table of Contents</li> <li>• Articles</li> <li>• Captioned Pictures/Illustrations</li> <li>• Chart, Graph, or Timeline</li> <li>• Advertisements</li> <li>• Cover</li> </ul>	<p>The magazine puts together the concepts using all of the required elements</p> <ul style="list-style-type: none"> <li>• Table of Contents</li> <li>• Articles</li> <li>• Captioned Pictures/Illustrations</li> <li>• Advertisements</li> <li>• Chart, Graph, or Timeline</li> <li>• Cover</li> </ul>	<p>The magazine puts together the concepts using most of the required elements</p> <ul style="list-style-type: none"> <li>• Table of Contents</li> <li>• Articles</li> <li>• Captioned Pictures/Illustrations</li> <li>• Advertisements</li> <li>• Chart, Graph, or Timeline</li> <li>• Cover</li> </ul>	<p>The magazine does not use most of the required elements</p> <ul style="list-style-type: none"> <li>• Table of Contents</li> <li>• Articles</li> <li>• Captioned Pictures/Illustrations</li> <li>• Advertisements</li> <li>• Chart, Graph, or Timeline</li> <li>• Cover</li> </ul>
<b>Mechanics and Grammar</b>	<p>The magazine has few to no errors in mechanics or grammar; if there are any, they are so minor that they are almost overlooked by the reader</p>	<p>The magazine has some noticeable errors in mechanics or grammar, but these do not make it hard to understand</p>	<p>The magazine has noticeable errors in mechanics or grammar; they sometimes make it hard to understand</p>	<p>The magazine has many errors in mechanics or grammar; they often make it hard to understand</p>	<p>The magazine has so many errors in mechanics or grammar that most of it is hard to understand</p>
<b>Neatness</b>	<p>The magazine is extremely neat from cover to cover; there are no corrections, creases or wrinkles, tears, or spots that can be seen</p>	<p>The magazine is neat from cover to cover with very few corrections, creases or wrinkles, tears, or spots that can be seen</p>	<p>The magazine is neat overall, but there are some areas with corrections, creases or wrinkles, tears, or spots that can easily be seen</p>	<p>The magazine is messy in many places; there are many areas with corrections, creases or wrinkles, tears, or spots that are very easy to see</p>	<p>The magazine is messy from cover to cover; areas with corrections, creases or wrinkles, tears, or spots make the reader forget about the content</p>
<b>Originality</b>	<p>The magazine is a model of original work with original ideas; all sources are correctly cited</p>	<p>The magazine is original work, but not original ideas; all sources are correctly cited</p>	<p>The magazine has some original work but many copied ideas; some sources are correctly cited</p>	<p>The magazine contains little original work and few original ideas; some sources are cited</p>	<p>The magazine is clearly not original work; very few ideas are original; sources are not cited</p>

## Evaluation Form for Magazine Assessment

Groups'  
Names \_\_\_\_\_

Evaluator(s) Name(s) (Peer) \_\_\_\_\_

Date \_\_\_\_\_

**Directions:** Circle the number that best represents the level of quality of each component of the magazine. Provide at least two (2) pieces of evidence to support your evaluation.

Components of Magazine	Self Evaluation	Peer Evaluation	Instructor Evaluation	Summary
<b>Concepts</b>	5 4 3 2 1 0 Evidence	5 4 3 2 1 0 Evidence	5 4 3 2 1 0 Evidence	
<b>Magazine Elements</b>	5 4 3 2 1 0 Evidence	5 4 3 2 1 0 Evidence	5 4 3 2 1 0 Evidence	
<b>Mechanics and Grammar</b>	5 4 3 2 1 0 Evidence	5 4 3 2 1 0 Evidence	5 4 3 2 1 0 Evidence	

## Evaluation Form for Magazine Assessment (continued)

Groups'  
Names \_\_\_\_\_

Evaluator(s) Name(s) (Peer) \_\_\_\_\_

Date \_\_\_\_\_

**Directions:** Circle the number that best represents the level of quality of each component of the magazine. Provide at least two (2) pieces of evidence to support your evaluation.

Components of Magazine	Self Evaluation	Peer Evaluation	Instructor Evaluation	Summary
<b>Neatness</b>	5   4   3   2   1   0 Evidence	5   4   3   2   1   0 Evidence	5   4   3   2   1   0 Evidence	
<b>Originality</b>	5   4   3   2   1   0 Evidence	5   4   3   2   1   0 Evidence	5   4   3   2   1   0 Evidence	

## Final Reflection

Standards Addressed	
<b>LANGUAGE ARTS</b> <b>WRITING</b> W-E1, PO 1-5 W-E4	<b>TECHNOLOGY</b> 3T-E1 4T-E2, PO 1

**Time Allotment:** Two Weeks (As Homework and In Class During Free Time)

**Materials Needed:** Individual Student Information (Varies with Student)  
 Paper and Writing Implements  
 Computer (Optional for Word Processing)  
 Six-trait Writing Rubric (pp. 59-62)

**Procedure:** Upon reading other students' magazines and reviewing their own, have individual students write a multi-paragraph essay reflecting on the entire experience stating the importance of mining and minerals in their lives now and in the future. Direct students to include information about the historical significance of mining geological considerations, uses, and economic concerns. Further direct students to use all of the information they have amassed in their study and the six-trait writing rubric to guide and direct their work. Allow students to use self and peer evaluation and suggestions to improve their work prior to submitting their essay.

## Outcome 1 Learning Experiences

### A. Copper Mining’s Role in Arizona — Past, Present, and Future

*Understand the important role of copper mining in Arizona by*

investigating relevant people, places, and events in the state’s past;

*(All learning experiences in the unit will include vocabulary development activities.)*

#### Learning Experience 1

Standards Addressed	
<b>SOCIAL STUDIES</b> 1SS-E1, PO 1,2,4 1SS-E4, PO 3,4 1SS-E5, PO 2 3SS-E2, PO 1-3	<b>LANGUAGE ARTS — WRITING</b> W-E8, PO1 BULLETS 1,2,4  <b>LANGUAGE ARTS — READING</b> R-E1, PO 1-3 R-E2, PO 1-7
<b>TECHNOLOGY</b> 3T-E3, PO 1-2 4T-E2, PO 1	<b>LANGUAGE ARTS — VIEWING AND PRESENTING</b> BULLETS 1-2

#### Historic Timeline

**Time Allotment:** 3 days (in class and as homework)

**Materials Needed:** Roll paper  
 Writing and Drawing Implements  
 Timeline Rubric (p. 20)

**Reference Tools:** *Historical Atlas of Arizona*  
*The Mission, Means, and Memories of Arizona’s Miners*  
*From the Ground Up*  
*The History of Mining in Arizona*, vols. 1-3  
*The Story of Bisbee*  
 “The History of Bisbee” (timeline poster)  
 “Bisbee — The Copper Queen City” (video from *Copperstate Chronicles*)  
*Los Mineros* (video)  
 Encyclopedias (Internet or hard copy)  
 Mining Songs such as “Oh, My Darling, Clementine” and “Sixteen Tons”

- Procedure:** Teach students “Oh, My Darling, Clementine”, “Sixteen Tons”, and other mining songs as a mind set for the unit.  
Discuss the life of early miners and use illustrations from *The History of Mining in Arizona*, volumes 1-3 to show students the conditions associated with early mining.  
Discuss the gradual improvement in the life of a miner.  
Discuss Arizona’s mining history generally, reading to the students the introduction in *Copper the Mighty Metal*.  
Cut long pieces of roll paper (one piece for each group).  
Draw a horizontal line from end-to-end on each segment.  
Have students work in small groups and using the rubric conduct research of predetermined time spans in Arizona history to produce an annotated timeline for display in the room.  
When groups have completed their research and their part of the timeline, they will attach their segments in chronological order and present their findings to the rest of the class.  
Have students conduct self and peer evaluations using the rubric and providing evidence to justify their evaluations.  
Allow groups to revise their segments prior to the teacher evaluation.  
Discuss the enduring understanding that *exploration for and mining of copper has and will continue to impact society in many ways* in light of the class’s understanding of historic mining.
- Extension 1:** Have students find correlating national and world events and construct a correlating timeline or vertically add these events to their existing timeline so that students can get a sense of Arizona’s place compared to national and world events.
- Extension 2:** Students may produce a Power Point® presentation chronologically arranging significant historical events in Arizona history, Arizona mining history, the nation and the world and present it to the class.
- Reflection:** Have students reflect in their journals about copper’s impact on society.

## Timeline Rubric

### Levels of Quality

### Description

#### Excellent

- The timeline segment is neatly completed and easy to read. It has few to no errors in spelling, capitalization, punctuation, grammar or usage.
- The timeline segment is in chronological order and shows important historical events from Arizona's history.
- The timeline segment includes important Arizona historical mining events.

#### Satisfactory

- The timeline segment is neatly completed and easy to read. There are some errors in spelling, capitalization, punctuation, grammar or usage, but they do not make it hard to understand.
- The timeline segment is in chronological order and shows some important historical events from Arizona's history. There are some important events missing from the segment.
- The timeline segment shows some important Arizona historical mining events, but there are some important events missing.

#### Fair

- The timeline segment is not all neat. This makes it hard to read in places. There are errors in spelling, capitalization, punctuation, grammar or usage that make it hard to understand.
- Some historical events from Arizona's history are in chronological order, but there are important events missing from the segment.
- The timeline segment has some Arizona historical mining events, but there are important events missing.

#### Underdeveloped

- The timeline segment is messy and hard to read in many places. Errors in spelling, capitalization, punctuation, grammar or usage make it very hard to understand.
- Few historical events from Arizona's history are on the timeline segment in chronological order. Many important events are missing from the segment.
- Few Arizona historical mining events are shown on the timeline segment. Many important events are missing.

## Learning Experience 2

Standards Addressed
<p><b>SOCIAL STUDIES</b>            1SS-E3, PO 2,4            1SS-E4, PO 3-4            1SS-E5, PO 2            3SS-E2, PO 1-4</p>
<p><b>LANGUAGE ARTS — WRITING</b>            W-E8, PO 1            BULLETS 1-6</p> <p><b>LANGUAGE ARTS — READING</b>            R-E1, PO 1-3            R-E2, PO 1-7</p> <p><b>LANGUAGE ARTS — VIEWING AND PRESENTING</b>            BULLETS 2-3</p> <p><b>LANGUAGE ARTS — LISTENING AND SPEAKING</b>            BULLETS 1-3</p>

### Biography in the Flesh

**Time Allotment:** 1 week (in class and as homework)

**Materials Needed:** *The Mission, Means, and Memories of Arizona's Miners From the Ground Up*  
*The History of Mining in Arizona*, vols. 1-3  
*The Story of Bisbee*  
 "The History of Bisbee" (timeline poster)  
 "Bisbee — The Copper Queen City" (video from *Copperstate Chronicles*) (School Library or Arizona Mining Association's Video Lending Library)  
*Los Mineros* (video) (Arizona Mining Association's Video Lending Library)  
 Encyclopedias (Internet or hard copy)  
 Rubric for Oral Presentation (p. 22-23)

**Procedure:** Review with students Arizona's mining history and the people and places involved. Have students research one of the famous people or places important to mining history and give an oral presentation to the class either taking on the persona of the person or place, or giving a report about the person or place. Discuss *mining's impact on society* in light of the people and places involved.

## Rubric for Oral Presentation

Elements	Levels of Quality				
	<i>Excellent</i>	<i>Good</i>	<i>Fair</i>	<i>Underdeveloped</i>	<i>No Attempt</i>
<b>Presentation</b>	<p>The presentation</p> <ul style="list-style-type: none"> <li>• is well organized</li> <li>• shows attention to highlights</li> <li>• includes interesting details</li> <li>• has smooth transitions</li> <li>• shows much thought given to planning</li> </ul>	<p>The presentation</p> <ul style="list-style-type: none"> <li>• is well organized</li> <li>• shows some attention to highlights</li> <li>• includes some interesting details</li> <li>• has transitions</li> <li>• shows some thought given to planning</li> </ul>	<p>The presentation</p> <ul style="list-style-type: none"> <li>• has basic organization</li> <li>• shows some attention to a few highlights</li> <li>• includes some details</li> <li>• lacks transitions</li> <li>• shows minimal thought given to planning</li> </ul>	<p>The presentation</p> <ul style="list-style-type: none"> <li>• is not organized</li> <li>• shows little attention to highlights</li> <li>• includes few details</li> <li>• lacks transitions</li> <li>• shows little to no thought given to planning</li> </ul>	
<b>Engagement of Audience</b>	<p>The presenter successfully and actively keeps the audience's attention throughout the presentation</p>	<p>The presenter successfully keeps the audience's attention through the majority of the presentation</p>	<p>The presenter successfully keeps the audience's attention through some of the presentation</p>	<p>The presenter does not successfully keep the audience's attention through most of the presentation</p>	
<b>Use of Sources</b>	<p>There is a consistent connection between the sources and the presentation. It is obvious that more than one source has been used to put together the presentation.</p>	<p>There is a connection between the sources and the presentation. It is obvious that more than one source has been used to put together the presentation.</p>	<p>There is only a weak connection between the sources and the presentation. It is not obvious that more than one source has been used to put together the presentation.</p>	<p>There is not an evident connection between the sources and the presentation. It is questionable that more than one source has been used to put together the presentation.</p>	
<b>Knowledge of Subject</b>	<p>There is a strong understanding of the topic. The presentation is factually correct, accurate, and consistent. The presentation shows a careful attention to the selection of information.</p>	<p>There is a good understanding of the topic. The presentation is factually correct, accurate, and consistent in most cases. The presentation shows attention to the selection of information</p>	<p>There is a general understanding of the topic. The presentation is factually correct, accurate, and consistent in some cases. The presentation shows some attention to the selection of information</p>	<p>There is a lack of understanding of the topic. The presentation is sometimes factually correct, and accurate, but lacks consistency much of the time. The presentation shows little attention to the selection of information</p>	

## Rubric for Oral Presentation (continued)

Elements	Levels of Quality				
	<i>Excellent</i>	<i>Good</i>	<i>Fair</i>	<i>Underdeveloped</i>	<i>No Attempt</i>
<b>Use of Media</b>	The use of visuals gives additional important information about the topic making it very easy for the audience to understand the presentation.	The use of visuals gives some additional important information about the topic making it easy for the audience to understand the presentation.	The use of visuals gives some additional information about the topic but does not always make it easy for the audience to understand the presentation.	The use of visuals gives little additional information about the topic so the it does not make the presentation easier for the audience to understand.	
<b>Speaking Skills</b>	<p>The presenter uses</p> <ul style="list-style-type: none"> <li>• clear enunciation</li> <li>• strong projection</li> <li>• vocal variety</li> <li>• eye contact with entire audience</li> <li>• presentation posture</li> <li>• solid focus without interruptions</li> </ul>	<p>The presenter uses</p> <ul style="list-style-type: none"> <li>• good enunciation</li> <li>• adequate projection</li> <li>• partial eye contact with the audience</li> <li>• appropriate posture</li> <li>• focus with few interruptions</li> </ul>	<p>The presenter uses</p> <ul style="list-style-type: none"> <li>• inconsistent enunciation</li> <li>• low projection</li> <li>• infrequent eye contact with the audience</li> <li>• inconsistent posture</li> <li>• little focus with many interruptions</li> </ul>	<p>The presenter uses</p> <ul style="list-style-type: none"> <li>• poor enunciation</li> <li>• low projection</li> <li>• little or no eye contact with the audience</li> <li>• poor or distracting posture</li> <li>• infrequent focus with interruptions that make it difficult to follow the presentation</li> </ul>	

## Evaluation Form for Oral Presentation

**Presenter's Name** \_\_\_\_\_ **Date** \_\_\_\_\_

**Evaluator's Name** \_\_\_\_\_

Use the oral presentation rubric to select the level of quality that best describes the presentation and the presenter. In the blank provide evidence for your evaluation of the presentation.

Elements	Levels of Quality				
	<i>Excellent</i>	<i>Good</i>	<i>Fair</i>	<i>Underdeveloped</i>	<i>No Attempt</i>
<b>Presentation</b>					
<b>Engagement of Audience</b>					
<b>Use of Sources</b>					
<b>Knowledge of Subject</b>					
<b>Use of Media</b>					
<b>Speaking Skills</b>					

*Understand the important role of copper mining in Arizona by*

Describing the current status of copper mining operations and their impact on the state's economy and

Predicting or projecting the future of Arizona's copper industry.

### Learning Experience 3

<b>Standards Addressed</b>	
<b>SOCIAL STUDIES</b> 4SS-E2, PO 1 4SS-E3, PO 1	<b>TECHNOLOGY</b> 5T-E1, PO 1,2,5
<b>LANGUAGE ARTS</b> <b>READING</b> R-E1, PO 1-3 R-E2, PO 1-7	<b>LISTENING AND SPEAKING</b> BULLET 3

### Guest Speaker

**Time Allotment:** 2 days (in class and as homework)

**Materials Needed:** Overhead Projector  
 Proxima Projector (if needed)  
 Chalkboard or White Board  
 Learning Report Summary Sheets from Arizona Mining Association Website [www.azcu.org](http://www.azcu.org)

**Procedure:** Read summary sheets for 1996-1999 from the Learning Report [www.azcu.org](http://www.azcu.org) and highlight important points from summary sheets  
 Invite a guest speaker ASARCO, BHP Billiton, or Phelps Dodge to address the class about the current and possibly future conditions in the mining industry.  
 Have students take notes as they listen to the speaker. Allow time for Q & A.

## Learning Experience 4

Standards Addressed	
<b>SOCIAL STUDIES</b> 1SS-E1, PO 1-2 4SS-E2, PO 1 4SS-E3, PO 1	<b>TECHNOLOGY</b> 5T-E1, PO 1,2,5
<b>LANGUAGE ARTS</b> <b>WRITING</b> W-E1, PO 1-5 W-E3 W-E5, PO 3 W-E8, PO 1 BULLETS 1-6	<b>VIEWING AND PRESENTING</b> BULLET 2  <b>READING</b> R-E1, PO 1-3 R-E2, PO 1-7

### Discussion and Group Summary Bulletin Board

**Timeline:** 2 Days (in class)

**Materials Needed:** Bulletin Board  
 Writing and Drawing Materials  
 Learning Report Summary Sheets from [www.azcu.org](http://www.azcu.org)  
 Bulletin Board Checklist (p. 27)

**Procedure:** Divide the class into “Think, Pair, Share” groups and, using their notes from the “Learning Report Summary Sheets” and from the guest speaker, allow students to discuss their understanding about the present and future of the copper mining industry. Discuss the significant information and the following enduring understandings: *exploration for and mining of copper has and will continue to impact society in many ways; and in a free market system there are not enough resources to satisfy all the desires of all people, so there has to be some way of deciding who gets what* as a class. Have the class use the “Bulletin Board Checklist” to construct a bulletin board summarizing their understandings.

## Bulletin Board Checklist

Date \_\_\_\_\_

As you complete the bulletin board, check all of the following items:

- The bulletin board has a title.
- The bulletin board is easy to read from the back of the room.
- The use of color aids in understanding of the content of the bulletin board.
- The bulletin board has been completed neatly and is attractive.
- There are no mistakes in capitalization, punctuation, spelling, grammar, or usage on the bulletin board.
- The composition (arrangement) of the bulletin board makes it easy to understand its content.
- The bulletin board clearly and correctly summarizes what the class has learned about the economic picture of the Arizona copper mining industry.
- The bulletin board shows the enduring understandings discussed in class.

**Learning Experience 4 (Alternative)**

<b>Standards Addressed</b>	
<b>SOCIAL STUDIES</b> 1SS-E1, PO 1-2 4SS-E2, PO 1 4SS-E3, PO 1	<b>TECHNOLOGY</b> 3T-E1, PO 1-2 3T-E4, PO 1 5T-E1, PO 1,2,5
<b>LANGUAGE ARTS</b> <b>WRITING</b> W-E1, PO 1-5 W-E3 W-E5, PO 3 W-E8, PO 1 BULLETS 1-6	<b>VIEWING AND PRESENTING</b> BULLET 2  <b>READING</b> R-E1, PO 1-3 R-E2, PO 1-7

**Internet Connection**

- Time Allotment:** Up to 3 Days in Class
- Materials Needed:** Computer Lab or Multiple Computers  
 Internet Access  
 Printer  
 Paper and Writing Implements  
 Six-trait Writing Rubric (pp. 59-62)
- Procedure:** Divide the class so that everyone has individual to small-group access to a computer.  
 Have students access the Internet and call up [www.azcu.org](http://www.azcu.org)  
 Have students study the company descriptions and the summaries of the *Learning Report* therein.  
 Discuss students' findings. Discuss the idea that *in a free market system there are not enough resources to satisfy all the desires of all people, so there has to be some way of deciding who gets what.*  
 Have each student use the computer and their word processing skills to write an editorial or letter to the editor about the need for mining, the current conditions in mining, and the possible future of mining in Arizona relative to the idea that *in a free market system there are not enough resources to satisfy all the desires of all people, so there has to be some way of deciding who gets what.*  
 The editorial or letter to the editor should include the student's opinion about the need for mining and future of mining in Arizona and cite evidence from his or her research to back up the opinion.  
 Have students self and peer evaluate the product using the six-trait writing rubric.  
 Allow students time to revise their work prior to teacher evaluation.

## Learning Experience 5

Standards Addressed	
<b>SOCIAL STUDIES</b> 4SS-E2, PO 1 4SS-E3, PO 1	<b>TECHNOLOGY</b> 5T-E3, PO 1,3,5
<b>LANGUAGE ARTS</b> <b>WRITING</b> W-E8, PO 1  <b>LISTENING AND SPEAKING</b> BULLETS 1-3	<b>READING</b> R-E1, PO 1-3 R-E2, PO 1-7  <b>VIEWING AND PRESENTING</b> BULLETS 1-3

### Debate

**Time Allotment:** 3 Days in Class and as Homework

**Materials Needed:** “Leaming Report Summary Sheets” from Arizona Mining Association Website [www.azcu.org](http://www.azcu.org)  
 Notes from Guest Speaker  
 Information from Internet about Copper Mining Present and Future ([www.phelpsdodge.com](http://www.phelpsdodge.com) [www.asarco.com](http://www.asarco.com))  
 Rubric for Debate (p. 30)

**Procedure:** Have students form 5-member teams and using the information they have gathered from their research about the present and future of Arizona’s copper mining industry, the idea that *in a free market system there are not enough resources to satisfy all the desires of all people, so there has to be some way of deciding who gets what*, as well as any additional material they have been able to locate on the Internet, at the library, etc.  
 Have them prepare to debate the future of Arizona’s copper mining industry. **Resolved:** In the 21<sup>st</sup> century Arizona’s copper mining industry will play a leading world role. **Resolved:** In the 21<sup>st</sup> century Arizona’s copper mining industry will employ thousands more people than it does today.  
 Hold the debates and have students vote on the winners based on the information each side presents and their rebuttals.  
 Discuss the debates as a class.

## Rubric for Debate

	<b>Levels of Quality</b>			
	<b>Outstanding</b>	<b>Satisfactory</b>	<b>Fair</b>	<b>Below Minimum Expectations</b>
<b>Elements</b>				
<b>Information</b>	The information presented by the affirmative side was correct, to the point, and presented a point of view that clearly supported the resolution.	The majority of the information presented by the affirmative side was correct, to the point, and presented a point of view that almost always supported the resolution.	Some of the information presented by the affirmative side was correct and presented a point of view that supported the resolution.	Little of the information presented by the affirmative side was correct or presented a point of view that supported the resolution.
<b>Rebuttal Points</b>	The rebuttal team presented strong, factual, convincing arguments against the resolution.	The rebuttal team presented factual, convincing arguments against the resolution, however, they were not as strong as in an outstanding presentation.	The rebuttal team presented factual arguments against the resolution, however, they were not as strong or convincing as in a satisfactory presentation.	The rebuttal team failed to present factual arguments against the resolution, they mainly used vague, generalized statements.
<b>Stage Presence</b>	Each team member spoke loudly and slowly enough for the entire audience to hear and understand. They were knowledgeable about the resolution and were very poised.	The majority of the team spoke loudly and slowly enough for the entire audience to hear and understand. They were knowledgeable about the resolution, displaying nervousness only a very few times.	A few members of the team spoke loudly and slowly enough for the entire audience to hear and understand. Some were knowledgeable about the resolution; there were many displays of nervousness.	The majority of the team did not speak loudly and slowly enough for the entire audience to hear and understand. Few were knowledgeable about the resolution, and most members were nervous throughout.
<b>Following Rules</b>	The entire team followed correct debating procedure and rules.	The majority of the team followed correct debating procedure and rules.	The majority of the team had some difficulty following correct debating procedure and rules.	The team had great difficulty following correct debating procedure and rules.

# Evaluation Form for Debate

Team \_\_\_\_\_ Date \_\_\_\_\_

Evaluators \_\_\_\_\_

**Directions:** Determine the level of quality for each element and in the space under the level of quality, provide at least two pieces of evidence to support your evaluation.

	Levels of Quality			
	Outstanding	Satisfactory	Fair	Below Minimum Expectations
<b>Elements</b>				
<b>Information</b>				
<b>Rebuttal Points</b>				
<b>Stage Presence</b>				
<b>Following Rules</b>				

## Outcome 2 Learning Experiences

### B. Copper as a Mineral and a Commodity

*Describe the formation of copper and where it is found in the earth by*

outlining the concept of plate tectonics;

#### Learning Experience 1

Standards Addressed	
<b>SCIENCE</b> 6SC-E3, PO 1-2 6SC-E5, PO 1	
<b>LANGUAGE ARTS</b> <b>WRITING</b> W-E1, PO 1-5 W-E3	<b>READING</b> R-E1, PO 1-3 R-E2, PO 1-7

#### Video and Poster

- Time Allotment:** 3 Hours (In Class)
- Materials Needed:** *Plate Tectonics* Video (Arizona Mining Association's Video Lending Library)  
 Mercator Projection of the World  
 Poster Board  
 Checklist for Visual Product (p. 36)
- Procedure:** Have class view the video *Plate Tectonics*.  
 Discuss vocabulary associated with plate tectonics, and have students add to vocabulary list each term and its definitions.  
 Discuss the theory and concept of plate tectonics, stressing lithospheric plate movement.  
 Duplicate a Mercator projection of the world for each student.  
 Have the students cut each land mass away from the rest of the land masses and add a continental shelf around each land mass. (Model this step for the students.)  
 Allow students to fit the pieces of the world maps together to form a representation of Pangea.  
 Discuss the idea that *the modern theory of plate tectonics, which serves as a unifying principle in geology, provides an explanation for the large and diverse array of phenomena related to the earth's surface.*  
 Have students affix their super continent to a poster board and add descriptions of the forces and phenomena that influence the movement of the plates using the "Checklist for Visual Product" as a guide for their work.

## Learning Experience 2

Standards Addressed	
<b>SCIENCE</b> 6SC-E3, PO 1-2 6SC-E5, PO 1	
<b>LANGUAGE ARTS</b> <b>WRITING</b> W-E1, PO 1-5 W-E3	<b>READING</b> R-E1, PO 1-3 R-E2, PO 1-7

### Sand Faulting and Folding

**Time Allotment:** 45 minutes

**Materials Needed:** 4" x 6" Index Cards  
 Fine Sand, Sugar, or Salt  
 8 1/2" x 11" Paper  
 Students' Individual Journals

**Procedure:** Discuss with students their understanding of plate tectonics. Discuss the idea that *the modern theory of plate tectonics, which serves as a unifying principle in geology, provides an explanation for the large and diverse array of phenomena related to the earth's surface.*

Discuss various types of folding and faulting.  
 Demonstrate the process described below:  
 Distribute materials to pairs of students.  
 Direct students to place 2 index cards on the 8 1/2" x 11" paper overlapping them so the top card covers 1/2 of the bottom card.  
 Direct students to pour a little sand (sugar or salt) on the cards where they overlap.  
 Have students slide the bottom index card toward the top of the paper and observe the result. Discuss the shift in the pattern of sand. Have students identify the type of fault illustrated and draw and describe it in their journals.  
 (After each movement, have students lift the index cards from the paper and place used sand in a container. Direct students to begin again by replacing the index cards and the sand.)  
 Continue the demonstration with the students, leading them to understand subduction, rifts, folding, and faulting.  
 Have students summarize in their journals the various motions they have illustrated from the demonstration and the idea that *the modern theory of plate tectonics, which serves as a unifying principle in geology, provides an explanation for the large and diverse array of phenomena related to the earth's surface.*

### Learning Experience 3

Standards Addressed	
<b>SCIENCE</b> 6SC-E3, PO 1-2 6SC-E5, PO 1	<b>LANGUAGE ARTS — READING</b> R-E1, PO 1-3 R-E2, PO 1-7  <b>LANGUAGE ARTS — VIEWING AND PRESENTING</b> BULLET 1

### Volcanoes — Mighty Forces That Shape Our Earth

**Time Allotment:** 2 Class Periods and as Homework if Needed

**Materials Needed:** *The Earth 3D* CD-ROM  
*This Dynamic Planet* (Map)  
*Arizona Geologic Highway Map*  
*Arizona's Active Mines Map 2000*  
*Copper the Mighty Metal* (booklet)  
 Information about Porphyry Copper Deposits  
 Paper (Or Poster Board) and Writing Implements  
 Blackboard, White Board, or Overhead Projector (Optional)  
 Students' Individual Journals  
 Checklist for Visual Product (p. 36)

**Procedure:** Display the following maps: *This Dynamic Planet*, *Geologic Highway Map of Arizona*, and *Arizona's Active Mines — 2000*. Review volcanoes with students. Discuss how a volcano works, types of volcanoes, where volcanic activity has and is occurring. Point out the “Ring of Fire” on *This Dynamic Planet*. Throughout the discussion, have students take notes in their journals. Show *The Earth 3D* CD-Rom (the part about volcanoes). Discuss the contents. Have students analyze the presentation for language, subject matter, and visual techniques. Discuss in general the volcanic formation of mineral deposits. Read and discuss pp. 5-7 in *Copper the Mighty Metal*. Discuss and illustrate on the blackboard white board or overhead the formation of a porphyry copper deposit. Discuss the contents of a geologic map. Discuss the types of rocks found with porphyry copper deposits. On *the Geologic Highway Map of Arizona* have students identify these rocks. Lead students to discover the “copper belt” by identifying Arizona copper mines using the geologic map and the active mines map. On paper or poster board have individuals or pairs of students draw a cross section of each volcano type labeling the parts. Have students use the “Checklist for Visual Project” as a guide. Compare and discuss the posters. Discuss the reasons copper mines are not everywhere in Arizona.

*Describe the formation of copper and where it is found in the earth by*

tracing the development of igneous, sedimentary, and metamorphic rocks;

#### Learning Experience 4

<b>Standards Addressed</b>	
<b>SCIENCE</b> 6SC-E3, PO 1-2 6SC-E5, PO 1	<b>LANGUAGE ARTS — READING</b> R-E1, PO 1-3 R-E2, PO 1-7  <b>LANGUAGE ARTS — WRITING</b> W-E1, PO 1-5 W-E3

#### Rock Cycle Model

- Time Allotment:** 4-6 Days (minimum 1 day for review of earth's layers and volcanism, 1 day for research, 1 day for reporting, 1 day for models)
- Materials Needed:** Guiding Questions about Layers of the Earth and the Forces That Have Shaped It  
*The Rock Cycle* Video (AMA Video Lending Library)  
 Reference Books (See Resources and References pp. 67-68)  
 Checklist for Visual Product (p. 36)
- Procedure:** Provide students guiding questions about the layers of the earth and forces that have shaped it as a springboard to a paired oral review culminating in a class review and generation of review classroom charts about the earth's layers and volcanism. Guiding questions will be determined by the individual class's prior knowledge of the topic.  
 Show the video *The Rock Cycle* and have students explain the rock cycle orally and illustrate it on the chalk or white board.  
 Have students work in pairs to research a rock type and its position(s) in the rock cycle. (The class should be grouped so that an equal number of groups work on each rock type.)  
 Direct all of the pairs who worked on a certain rock type to pool their knowledge to be presented to the other two groups.  
 Have each group report the pooled information to the class.  
 Direct each student to draw or make a model of the rock cycle.
- Extension:** Invite students to make a plate tectonics, volcano, or rock cycle game and present it to the class.  
 Allow students to work in small groups or individually to produce their game, and allow students to produce aboard game, a card game, or a playground game.  
 As a requirement, direct students to develop a game that reviews or teaches the concepts of the physical phenomenon they select.

## Checklist for Visual Product

Name \_\_\_\_\_ Date \_\_\_\_\_

As you complete your product, check all of the following items that apply to the product you are constructing. Once your product is complete, revisit the checklist to make sure the elements reflect the checklist descriptions.

### Appearance

1. \_\_\_\_\_ My product is completed neatly with no distracting erasures, wrinkles, tears, dog-eared corners, greasy marks, smudges, fingerprints, etc.
2. \_\_\_\_\_ My product is proportioned correctly (If it is a poster, it fills the poster board well with no left over spaces or cramped areas. If it is a three-dimensional product, all of the parts are sized so that the entire product looks good.)
3. \_\_\_\_\_ My product has few to no spelling, capitalization, punctuation, or grammar and usage errors. If there are these types of errors, they are not noticeable to the viewer.

### Content

4. \_\_\_\_\_ My product contains all of the necessary elements.
5. \_\_\_\_\_ My product is arranged correctly.

### Originality

6. \_\_\_\_\_ I did not just copy this product from a book or other resource. It is my own idea.

### Knowledge of Content

7. \_\_\_\_\_ I understand and can talk about the content of my product.

### Self Evaluation

\_\_\_\_\_ I have checked all seven elements because I know they are in my product and show my knowledge of the assigned work. I think the product is ready to show to others.

\_\_\_\_\_ I have checked more than half of the elements, but I still could do some of the elements better. I think the product is ready to show to others.

\_\_\_\_\_ I have not checked more than half of the elements because I am still learning how to create a good visual product. I would like some help with this task before I show the product to others.

\_\_\_\_\_ I have not checked more than half of the elements because I need more time to complete the task. I would like a time extension before I show the product to others.

If you need more time, how much will you need to complete the task? \_\_\_\_\_

**Extension:** Invite students to bring to class examples of each type of rock — (igneous, sedimentary, and metamorphic) and make a class rock collection with the rocks grouped and labeled according to type. If possible, with teacher, expert, or reference book assistance, have students identify each rock sample specifically.

*Describe the formation of copper and where it is found in the earth by*

distinguishing among atoms, elements, crystals, minerals, and rocks.

### Learning Experience 5

<b>Standards Addressed</b>	
<b>SCIENCE</b> 5SC-E1, PO 1-3 6SC-E3, PO 1-2	<b>LANGUAGE ARTS — READING</b> R-E1, PO 1-3 R-E2, PO 1-7  <b>LANGUAGE ARTS — WRITING</b> W-E1, PO 1-5 W-E3

### Atoms, Elements, Crystals, Minerals, and Rocks

**Time Allotment:** 1 Day

**Materials Needed:** Cookies Containing a Variety of Ingredients (Chocolate Chips, Nuts, M&M's, Raisins, Coconut, etc.)  
 Sugar  
 Pieces of Granite or Other Rocks  
 Hand Lenses (Optional)  
*The Mining Industry and Minerals* Newspaper (Background and Follow-up)

**Procedure:** Background information for this experience and the directions follow.

## ELEMENTS, CRYSTALS, MINERALS, ROCKS

Everything is made of elements, the basic building blocks of nature. Many elements have a crystalline structure. Often, when two or more of these structures are combined, the result is a mineral. (Strictly speaking, a single mineral is often considered an element, and not all crystalline structures are always classified as minerals.) Rocks are often made of combinations of minerals. (A rock can also be a single mineral i.e. limestone.) Many times the components that make up rocks are easy to see, while at other times they are not. The following activity can illustrate the components that make up rocks.

- Demonstration:** Distribute a cookie to pairs of students.  
 Instruct students to pretend that the cookie is a rock. Allow them to pull apart the cookie to find its components.  
 Have students sort the parts of the cookie, putting like items in the rectangles on the worksheet.  
 Discuss what the parts of the cookie represent. (Minerals)  
 Have students write the names of the cookie's parts on the lines at the bottom of each rectangle.  
 (If the cookie contains M&M's, have students carefully break apart an M&M to observe its parts. Discuss what the parts of the M&M could represent. (Crystals, Elements) Have students label these parts on the lines at the bottom of the M&M rectangle.)  
 Discuss the parts of the cookie students cannot see (flour, sugar, eggs, butter, etc.). Discuss what these parts could represent. (Elements, Crystals)  
 Distribute a small amount of sugar to students. Have them use the hand lens to observe the sugar. Discuss the structure of the sugar (crystals).  
 Distribute a rock to each student.  
 Have them examine the rock with the hand lens. Discuss their observations.  
 Lead students to draw parallels between what they observe in the rock and what they saw in the cookie. (They might say that the parts of the cookie represented minerals, crystals, and elements, and that these are the components of rocks.)  
 Discuss the links among elements, crystals, minerals, and rocks.
- Lead students to understand society's dependence on minerals by discussing uses of minerals and the fact that mining depletes minerals.
  - Discuss renewable and nonrenewable resources.
  - Review historical events related to mining economics.
  - Discuss conservation of mineral resources.
  - Discuss the idea that *some minerals are very rare, and some exist in great quantities; but for practical purposes the ability to recover them is just as important as their abundance. As minerals are depleted, obtaining them becomes more difficult. Recycling and the development of substitutes can reduce the rate of depletion but may also be costly.*

## ~ Elements, Minerals, Gems, and Rocks ~

### What are They?

#### ~Element~

An element is a form of matter that contains only one kind of atom. An element cannot be broken down into simpler substances.

<b>H</b> Hydrogen																	<b>He</b> Helium
<b>Li</b> Lithium	<b>Be</b> Beryllium											<b>B</b> Boron	<b>C</b> Carbon	<b>N</b> Nitrogen	<b>O</b> Oxygen	<b>F</b> Fluorine	<b>Ne</b> Neon
<b>Na</b> Sodium	<b>Mg</b> Magnesium											<b>Al</b> Aluminum	<b>Si</b> Silicon	<b>P</b> Phosphorus	<b>S</b> Sulfur	<b>Cl</b> Chlorine	<b>Ar</b> Argon
<b>K</b> Potassium	<b>Ca</b> Calcium	<b>Sc</b> Scandium	<b>Ti</b> Titanium	<b>V</b> Vanadium	<b>Cr</b> Chromium	<b>Mn</b> Manganese	<b>Fe</b> Iron	<b>Co</b> Cobalt	<b>Ni</b> Nickel	<b>Cu</b> Copper	<b>Zn</b> Zinc	<b>Ga</b> Gallium	<b>Ge</b> Germanium	<b>As</b> Arsenic	<b>Se</b> Selenium	<b>Br</b> Bromine	<b>Kr</b> Krypton
<b>Rb</b> Rubidium	<b>Sr</b> Strontium	<b>Y</b> Yttrium	<b>Zr</b> Zirconium	<b>Nb</b> Niobium	<b>Mo</b> Molybdenum	<b>Tc</b> Technetium	<b>Ru</b> Ruthenium	<b>Rh</b> Rhodium	<b>Pd</b> Palladium	<b>Ag</b> Silver	<b>Cd</b> Cadmium	<b>In</b> Indium	<b>Sn</b> Tin	<b>Sb</b> Antimony	<b>Te</b> Tellurium	<b>I</b> Iodine	<b>Xe</b> Xenon
<b>Cs</b> Cesium	<b>Ba</b> Barium	<b>La</b> Lanthanum	<b>Hf</b> Hafnium	<b>Ta</b> Tantalum	<b>W</b> Tungsten	<b>Re</b> Rhenium	<b>Os</b> Osmium	<b>Ir</b> Iridium	<b>Pt</b> Platinum	<b>Au</b> Gold	<b>Hg</b> Mercury	<b>Tl</b> Thallium	<b>Pb</b> Lead	<b>Bi</b> Bismuth	<b>Po</b> Polonium	<b>At</b> Astatine	<b>Rn</b> Radon
<b>Fr</b> Francium	<b>Ra</b> Radium	<b>Ac</b> Actinium	<b>Rf</b> Rutherfordium	<b>Ha</b> Hahnium	<b>Sg</b> Seaborgium	<b>Ns</b> Nielsbohrium	<b>Hs</b> Hassium	<b>Mt</b> Meitnerium	<b>Uun</b> (Ununum)								
			<b>Ce</b> Cerium	<b>Pr</b> Praseodymium	<b>Nd</b> Neodymium	<b>Pm</b> Promethium	<b>Sm</b> Samarium	<b>Eu</b> Europium	<b>Gd</b> Gadolinium	<b>Tb</b> Terbium	<b>Dy</b> Dysprosium	<b>Ho</b> Holmium	<b>Er</b> Erbium	<b>Tm</b> Thulium	<b>Yb</b> Ytterbium	<b>Lu</b> Lutetium	
			<b>Th</b> Thorium	<b>Pa</b> Protactinium	<b>U</b> Uranium	<b>Np</b> Neptunium	<b>Pu</b> Plutonium	<b>Am</b> Americium	<b>Cm</b> Curium	<b>Bk</b> Berkelium	<b>Cf</b> Californium	<b>Es</b> Einsteinium	<b>Fm</b> Fermium	<b>Md</b> Mendelevium	<b>No</b> Nobelium	<b>Lr</b> Lawrencium	

#### ~Mineral~

A mineral is a naturally occurring, inorganic solid with a distinct internal structure and chemical composition. Minerals are made of elements.

#### ~Gem~

A gem is a mineral with natural beauty that has been cut, ground, and polished to enhance its beauty so that it can be used in objects of adornment.

#### ~Rock~

A rock is an earth material made of a mixture of one or more minerals, glass, mineraloids, or organic matter. Rocks can be classified as igneous, sedimentary, or metamorphic.

### Directions:

Inspect the "Mineral ABC's" list. Determine which of the listed entries are minerals and which are not. On your own paper draw a table with four columns headed **Element**, **Mineral**, **Gem**, and **Rock**. List all of the entries for each alphabet letter under its appropriate heading. Be prepared to discuss your findings and justify the placement of each entry.



*Examine the connections between copper's important properties and as a commodity in our modern lives by*

defining the following terms: *properties, commodity, economics* and *supply and demand*;  
 identifying and illustrating specific properties of copper;  
 developing the major categories of copper uses;  
 identifying specific uses of copper within developed categories; and  
 evaluating the importance of mineral resources in our lives using copper as a reference point.

### Learning Experience 6

Standards Addressed	
<b>SCIENCE</b> SSC-E1, PO 1-3	<b>LANGUAGE ARTS — READING</b> R-E1, PO 1-3 R-E2, PO 1-7  <b>LANGUAGE ARTS — WRITING</b> W-E1, PO 1-5 W-E3

### Properties of Minerals

**Time Allotment:** 2 Days in Class

**Materials Needed:** Arizona Minerals — Study Specimens (Arizona Department of Mines and Mineral Resources)  
 “Properties of Minerals” Worksheets and Handouts (pp. 43-46)  
 Glass streak plate  
 Nail or paper clip  
 Ceramic streak plate  
 Butcher paper  
 Markers  
 Writing Implements

**Procedure:** Distribute mineral specimens, glass and ceramic streak plates, and nail or paper clip.  
 Direct participants to sort the materials any way they wish (allow approximately 5 minutes).  
 Have participants relate the ways they sorted the materials. Record some of these on the butcher paper (color, shininess, weight, etc.).  
 Discuss the ways geologists sort materials and the need for a uniform system of classification.  
 Rename the terms used by participants to sort their minerals.  
 Hand out “Physical Properties of Minerals” work and fact sheets.  
 Have participants reclassify the mineral specimens according to the fact sheet, record findings on the worksheet (allow 5-10 minutes), and discuss the results.  
 Discuss the use of mineral identification handbooks.

Distribute the charts of mineral specimens and direct participants to use the data to identify their mineral specimens (allow 3-5 minutes).

Discuss the fact that in a non-structured situation (specimens from the field or other source), results such as those in this activity may be more difficult to achieve.

**Note:** It is important to allow participants time to sort minerals first without talking about geologists' methods.



## PHYSICAL PROPERTIES OF MINERALS

Following is a description of some of the physical properties used to identify minerals:

<b>Smell</b>	Earthy Sour Sweet Rotten Egg		<b>Hardness</b>	<b><u>Moh's Hardness Scale</u></b>	<b><u>Mineral Scratched by</u></b>
				1	
				2	<i>Fingernail</i>
				3	
<b>Luster</b>	the surface appearance of the mineral			4	<i>Penny (copper coin)</i>
	Glassy – Vitreous – <i>Shines like glass</i>			5	<i>Steel (knife blade, nail)</i>
	Earthy – Chalky – <i>Dull</i>			6	<i>Glass</i>
	Metallic – <i>Looks like metal</i>			7-10	<i>Will scratch steel or glass</i>
	Waxy, Silky, Pearly – <i>Has a muted shine</i>				
<b>Magnetic</b>	Attracts to a magnet				
<b>Streak</b>	Color the mineral leaves when scratched across a ceramic plate (unglazed porcelain)		<b>Specific Gravity</b>	Density or Heft – The ratio of the mass of the mineral to the mass of an equal volume of water (Does the specimen feel heavy for its size?)	
<b>Feel</b>	Texture of the mineral				
	Gritty <i>Sandy</i>				
	Powdery <i>Earthy or Chalky</i>		<b>Cleavage</b>	the pattern of breaking into regular planes	
	Smooth <i>Glass-like</i>				
	Smooth & Sticky <i>Waxy</i>		<b>Fracture</b>	the mineral breaks in an irregular, uneven manner	
	Sharp <i>Metallic</i>				
<b>Chemical</b>	Reacts to hydrochloric acid (fizzes)		<b>Color</b>	white, black, gray, green, yellow, blue, red, orange, brown, etc.	

A good mineral specimen book is helpful as is a good earth science textbook.

**PHYSICAL PROPERTIES OF MINERALS ACTIVITY**  
**TABLE OF MINERAL SPECIMEN CHARACTERISTICS**

Name and Chemical Formula	Luster	Density	Hardness			Fracture	Cleavage	Streak	Color
	Metallic or Non-metallic	Light Medium Heavy	Finger nail	Nail (paper clip)	Glass				
<i>Metallic Luster      Hardness 2½–5½</i>									
<b>Chalcopyrite</b> CuFeS <sub>2</sub> Copper Iron Sulfide	Metallic	4.3		4		Uneven		Yellow to brown	Brass Yellow
<b>Galena</b> PbS Lead Sulfide	Metallic	7.6		2½			Perfect	Gray	Gray
<i>Metallic Luster      Hardness greater than 5½</i>									
<b>Pyrite</b> FeS <sub>2</sub>	Metallic	5.0		6½		Uneven to conchoidal		Brown-black	Light brass-yellow
<b>Hematite</b> Fe <sub>2</sub> O <sub>3</sub> Iron Sulfide	Metallic	5.25		6		Splintery, uneven, conchoidal		Red-brown	Red to Black
<i>Non-metallic Luster      Hardness less than 2½</i>									
<b>Gypsum</b> CaSO <sub>4</sub> 2H <sub>2</sub> O Hydrous Calcium Sulfate	Non-Metallic	2.3-2.4		2			Perfect parallel to the long axis and distinct in two others	White	White, colorless with impurities then gray and brown
<b>Talc</b> Mg <sub>3</sub> Si <sub>4</sub> O <sub>10</sub> (OH) <sub>2</sub> Magnesium Hydroxyl Silicate	Non-Metallic	2.7-2.8		1			Perfect in one direction	White	Apple green to white, pink, gray

Name and Chemical Formula	Luster	Density	Hardness			Fracture	Cleavage	Streak	Color
	Metallic or Non-metallic	Light Medium Heavy	Finger nail	Nail (paper clip)	Glass				

*Non-metallic Luster Hardness greater than 2½ but less than or equal to 5½*

<b>Calcite</b> CaCO <sub>3</sub> Calcium Carbonate	Non-Metallic	2.71		3			Perfect in three directions forming rhombohedrons	White	Clear to white, to shades of nearly all colors
<b>Barite</b> BaSO <sub>4</sub> Barium Sulfate	Non-Metallic	4.3-4.6		3-3½			Perfect in one direction	White	White, yellow, red, or brown

*Non-metallic Luster Hardness greater than 2½ and less than or equal to 5½*

<b>Chrysocolla</b> CuSO <sub>4</sub> 5H <sub>2</sub> O Copper Silicate Hydroxide	Non-Metallic	2-2.5		2½-4		Uneven to conchoidal		White to green or pale blue	Green to bluish-green
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*Non-metallic Luster Hardness greater than 5½*

<b>Quartz</b> SiO <sub>2</sub> Silicon Dioxide	Non-Metallic	2.65		7		Conchoidal		White	Colorless, white (milky), purple,
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*Conchoidal* fracture means that the specimen breaks so that the break looks like the rounded impression of a shell.

## Learning Experience 7

Standards Addressed	
<b>SCIENCE</b> 5SC-E1, PO 1-3	<b>SOCIAL STUDIES</b> 4SS-E3, PO 1
<b>LANGUAGE ARTS — WRITING</b> W-E1, PO 1-5 W-E3	<b>LANGUAGE ARTS — READING</b> R-E1, PO 1-3 R-E2, PO 1-7

### Properties and Uses of Copper

**Time Allotment:** 30 Minutes

**Materials Needed:** CDA *Copper Facts* Booklet  
*Copper the Mighty Metal* book  
 Paper and Pencil  
 12 and 16 Gauge Copper Wire  
 Hammer  
 Magnet  
 Heat Source (Flame)  
 Butcher Paper  
 Markers  
 Individual Students' Journals

**Procedure:** Discuss the properties and uses of copper.  
 Discuss the term *commodity* and the fact that farm goods and many natural resources such as copper are commodities.  
 Review society's need for mineral resources.  
 Divide the class into pairs and have them find and list on the butcher paper the properties of copper from *Copper the Mighty Metal*. Discuss and clarify as needed.  
 If possible, procure some 16 or 12 gauge copper wire, a magnet, and a hammer.  
 Discuss the nonmagnetic property of copper. Have students demonstrate malleability. (If supervised, apply heat to a length of the copper wire and with pliers at each end, demonstrate ductility).  
 Have students give examples of cases in which copper conducts heat and electricity.  
 List the properties of copper on the butcher paper to make a large chart.  
 Have groups of students (one group for each property) find and record on the chart uses of copper in *Copper Facts* appropriate to each property. (There may be more than one property for a particular use.)  
 For discussion highlight those uses about which the class was unaware.

On the butcher paper list the alloys of copper (found in *Copper Facts*). Have individual students name and record on the butcher paper under each alloy (from *Copper Facts* and their own experience) as many uses for copper alloys as they can.

For discussion highlight those uses about which the students were unaware.

Have students suggest alternatives to copper and the pros and cons based on copper's properties.

Discuss the reasons commodity markets fluctuate.

Discuss the ideas that *in a free market system there are not enough resources to satisfy all the desires of all people, so there has to be some way of deciding who gets what, and some minerals are very rare, and some exist in great quantities; but for practical purposes the ability to recover them is just as important as their abundance. As minerals are depleted, obtaining them becomes more difficult. Recycling and the development of substitutes can reduce the rate of depletion but may also be costly.*

## Learning Experience 8

Standards Addressed	
<b>SOCIAL STUDIES</b> 4SS-E2, PO 1 4SS-E3, PO 1	<b>LANGUAGE ARTS — READING</b> R-E1, PO 1-3 R-E2, PO 1-7  <b>LANGUAGE ARTS — WRITING</b> W-E1, PO 1-5 W-E3

### How Much is That Toaster in the Window?

**Time Allotment:** 1½ Hours

**Materials Needed:** 3 Toasters (optional)  
 3 Price Cards — one \$10.00, one \$20.00, and one \$40.00  
 Large Pieces of Butcher Paper (One for Each Group of People)  
 Markers

**Procedure:** Review the terms *economics* and *commodity*. Discuss the terms *supply* and *demand* and their reciprocal relationship to the commodities market and the economy.  
 Display toasters with the prices in front of room.  
 Discuss the *concept* of supply and demand and the numbers of people involved in producing and providing products to consumers. (Use the analogy of a lemonade stand and each step that is involved in producing and selling lemonade.) Have students provide other examples of the production-to-market process.  
 Discuss the concept of profit and loss.  
 Introduce session and activity.

Divide the class into groups of 3 to 5 students.

Have each group select a toaster.

Using the paper and markers, have each group trace the toaster from purchase to production identifying all the people who have touched it.

Have students consider each job as a unit of 1 (for the sake of simplicity).

In other words, the cashier at Wal-Mart is 1 unit even though there are hundreds of Wal-Mart cashiers.

When groups have determined the number of people involved in the toaster's production, have them do the math necessary to determine what part of the price of a toaster goes to each person involved.

Have each group display their "production path" and their financial conclusions. Discuss the variation in the results.

Discuss the concept of supply and demand in light of the class's findings.

Help students understand the concept of scarcity and *that in a free market system there are not enough resources to satisfy all the desires of all people, so there has to be some way of deciding who gets what.*

## Quiz 1

Standards Addressed	
<b>SOCIAL STUDIES</b> 4SS-E2, PO 1 4SS-E3, PO 1	<b>SCIENCE</b> 5SC-E1, PO 1-3 6SC-E3, PO 1-2
<b>LANGUAGE ARTS — WRITING</b> W-E1, PO 1-5 W-E3	<b>LANGUAGE ARTS — READING</b> R-E1, PO 1-3 R-E2, PO 1-7

**Time Allotment:** 1 Hour

**Materials Needed:** Quiz (pp. 50-51)  
 Paper and Writing Implements  
 Key (pp.52-53)

**Procedure:** Allow students to use any notes they may have about copper as a mineral and a commodity.  
 Distribute the quiz, go over the directions, and have students complete it.  
 Have students exchange papers and grade the quiz according to the key.  
 Discuss problem areas as needed.

Name \_\_\_\_\_ Date \_\_\_\_\_

## Quiz

### Copper as a Mineral and as a Commodity

Directions: Follow the directions in each section and provide the best response.

#### Section A Matching

Directions: Place the letter of the best match on the blank in front of the property or term.

- |                       |   |
|-----------------------|---|
| _____ Ductility       | A. A rock that was formed in fire   |
| _____ Conductivity    | B. A product or natural resource whose trading price is determined by supply and demand |
| _____ Igneous         | C. The ability of copper to bend or be shaped   |
| _____ Plate Tectonics | D. The ability of copper to repel bacteria  |
| _____ Malleability    | E. The ability of copper to be stretched  |
| _____ Metamorphic     | F. The ability of copper to transfer heat and electricity                               |
| _____ Biostaticity    | G. A rock that has been transformed by pressure and heat from its original form         |
| _____ Commodity       | H. The concept that the earth's land masses drift on top of the mantle                  |
| _____ Sedimentary     | I. A rock that was formed from deposits of material in layers under pressure            |

**Section B            Short Answer**

Directions:            Read each question or statement and respond using complete sentences.

1.     What is meant by the phrase *supply and demand*?

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2.     Describe the rock cycle.

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3.     In what ways is copper representative of mineral resources in general?

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4.     Because mineral resources are depleted with use, what are 3 ways we can conserve them?

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## Quiz

### Copper as a Mineral and as a Commodity

#### KEY

Directions: Follow the directions in each section and provide the best response.

#### Section A      Matching

Directions: Place the letter of the best match on the blank in front of the property or term.

- |                              |   |
|------------------------------|---|
| <u>  E  </u> Ductility       | A. A rock that was formed in fire   |
| <u>  F  </u> Conductivity    | B. A product or natural resource whose trading price is determined by supply and demand |
| <u>  A  </u> Igneous         | C. The ability of copper to bend or be shaped   |
| <u>  H  </u> Plate Tectonics | D. The ability of copper to repel bacteria  |
| <u>  C  </u> Malleability    | E. The ability of copper to be stretched  |
| <u>  G  </u> Metamorphic     | F. The ability of copper to transfer heat and electricity                               |
| <u>  D  </u> Biostaticity    | G. A rock that has been transformed by pressure and heat from its original form         |
| <u>  B  </u> Commodity       | H. The theory that the earth's land masses drift on top of the mantle                   |
| <u>  I  </u> Sedimentary     | I. A rock that was formed from deposits of material in layers under pressure            |

**Section B            Short Answer**

Directions:            Read each question or statement and respond using complete sentences.

1.     What is meant by the phrase *supply and demand*?

Supply is the quantity of a commodity available for purchase. Demand is the quantity of a commodity desired by consumers.

2.     Describe the rock cycle.

When the mantle of the earth escapes through the crust, lava is spewed forth. This material cools and solidifies forming igneous rocks. Igneous rocks may be broken down through weathering and erosion so that eventually they become smaller or are ground to fine grains of sand. This sand may blow on top of other sand, or it may be washed into rivers and deposited on top of other sand. Through time the weight of upper layers of sand forces lower layers of sand to fuse or cement together forming sedimentary rocks. Igneous, sedimentary, or even metamorphic rocks are eventually forced downward toward the mantle of the earth. Because of the extreme pressure and heat, their molecular structure is altered, and they become metamorphic rocks. The rock cycle is a constant action in which one kind of rock is changed into another over long periods of time again and again.

3.     In what ways is copper representative of mineral resources in general?

Copper is a good representative of mineral resources in general because it has many properties that make it useful to man. Its properties may be the same as other minerals or may be unique. For instance copper is biostatic, which means that bacteria won't grow on it. Aluminum does not possess this property, but like copper, aluminum is malleable and can be bent into many shapes. Copper is also representative of mineral resources in general because it is depleted through our use. Although we have plenty of copper, we are using more and more of it as time goes by. Copper is also recyclable as are many other mineral resources.

4.     Because mineral resources are depleted with use, what are 3 ways we can conserve them?

We can conserve mineral resources in three ways. One way is to find alternative uses for mineral resources such as substituting fiber optic glass for copper wires in the communications industry. Another way to conserve mineral resources is to recycle items made of minerals and thus find other uses for manufactured products. Copper from automobiles can be melted and reshaped into copper wire. Copper wire can be used for artistic items. A third way to conserve mineral resources is to find new and improved ways of obtaining them that are more efficient and that waste less of the raw materials in which the minerals we use are found. For example, today there are better ways to get more copper from ore than there were at the beginning of the 20<sup>th</sup> century.

**Extension**

<b>Standards Addressed</b>	
<b>SOCIAL STUDIES</b> 4SS-E2, PO 1 4SS-E3, PO 1	<b>SCIENCE</b> 5SC-E1, PO 1-3
<b>LANGUAGE ARTS — WRITING</b> W-E1, PO 1-5 W-E3	<b>LANGUAGE ARTS — READING</b> R-E1, PO 1-3 R-E2, PO 1-7

**Do You Know Your Mineral ABC's?**

<b>Time Allotment:</b>	1 Hour
<b>Materials Needed:</b>	“Do You Know Your Mineral ABC's?” Information Sheets (p. 55) Paper and Pencil
<b>Procedure:</b>	Distribute the worksheets. Have students examine the second sheet and discuss its contents and the activity directions. Allow students to work individually to complete the exercise. Discuss student's responses.

*Do You Know  
Your Mineral ABC's?*

**A** is for agate, alabaster aluminum, amethyst, antimony, apatite, aplite, arsenic, asbestos, augite

**B** is for barite, bauxite, beryl, beryllium, biotite, bismuth, boron, bromine

**C** is for cadmium, calcium, carbon, cement, cesium, chalk, chromium, citrine, clay, coal, cobalt, columbium, copper, corundum

**D** is for diamond, diatomite, dolomite, dysprosium

**E** is for elbaite, emerald, emery, epidote, europium

**F** is for feldspar, flint, fluorine, fluorspar

**G** is for gallium, garnet, gem stones, germanium, gneiss, gold, graphite, granite, gypsum

**H** is for hafnium, halite, helium, hematite

**I** is for indium, iodine, iridium iron

**J** is for jade, jasper

**K** is for kaolin, kimberlite, krypton, kyanite

**L** is for lava, lead, lime, limestone, lithium

**M** is for magnesium, manganese, marble, mercury, mica, molybdenum, muscovite

**N** is for nephrite, nickel, nitrogen, niobium

**O** is for obsidian, oil, oil shale, olivine, onyx, opal, osmiridium, osmium

**P** is for palladium, peat, perlite, phosphate, platinum, potash, potassium, pumice, pyromorphite

**Q** is for quartz

**R** is for rhodium, rhenium, rubidium, ruby, ruthenium, rhyolite

**S** is for salt, sand, sapphire, scandium, selenium, serpentine, shale, silicon, silver, schist, slate, sodium, stone, staurolite, steel, strontium, sulfur

**T** is for talc, tantalum, tellurium, thallium, thorium, tin, titanium, topaz, tourmaline, tungsten

**U** is for uranium

**V** is for vanadium, variscite, vermiculite

**W** is for wollastonite, wulfenite

**X** is for xanthene, xenon

**Y** is for yttrium

**Z** is for zeolite, zinc, zirconium

**Extension**

<b>Standards Addressed</b>	
<b>SOCIAL STUDIES</b> 4SS-E2, PO 1 4SS-E3, PO 1	<b>SCIENCE</b> 5SC-E1, PO 1-3
<b>TECHNOLOGY</b> 4T-E2, PO 1 5T-E1, PO 1-3	<b>LANGUAGE ARTS — WRITING</b> W-E1, PO 1-5 W-E8, PO 1 BULLETS 1-6  <b>LANGUAGE ARTS — READING</b> R-E1, PO 1-3 R-E2, PO 1-7

**Other Valuable Minerals**

**Time Allotment:** 1 Week (At Home or in Spare Time in Class)

**Materials Needed:** Rock and Mineral Reference Books (see “Resources and References” pp. 67-68)  
 The Internet  
 Science Text  
 Encyclopedias or Other Reference Books  
 Writing and Drawing Materials  
 Six-trait Writing Rubric (59-62)  
 Checklist for Charts (p. 57)

**Procedure:** Invite students to make an in-depth study of three minerals other than copper.  
 Have the students write a report, construct a chart, or make a combination of the two to discuss their findings about the minerals for display in class or for their personal journal.

## Checklist for Charts

Name \_\_\_\_\_ Date \_\_\_\_\_

As you complete your chart, use the checklist to guide your work. Upon completion of the chart, revisit the checklist to make sure you have included each element.

- My chart is completed neatly, and there are no distracting erasures, tears, wrinkles, spots from soda, bits, of Snickers<sup>®</sup> gum goo, etc. on it.
- My chart contains few to no spelling, capitalization, punctuation, or grammar and usage errors.
- My chart is organized so that it is easy to read.
- The information on my chart is accurate.
- My chart has a title.
- The information on my chart is complete and contains the following items:
  - The names of the minerals
  - At least three physical properties of each mineral
    - ◆ Streak
    - ◆ Hardness
    - ◆ Specific Gravity
    - ◆ Crystal Structure
    - ◆ Fracture
    - ◆ Cleavage
    - ◆ Luster
    - ◆ Color
  - At least three uses for each mineral

## Extension

### Rock Boxes

**Time Allotment:** Up to 1 Week in Class and at Home

**Materials Needed:** Assortment of Rocks  
Box  
Glue  
Cards for Labels  
Writing Implements  
Rock and Mineral Field Guides  
Notes

**Procedure:** Have students pair up with students in a primary class studying rocks.  
Direct students to use materials they have made and references they have used to explain the rock cycle and rock types to their primary partners.  
Allow partners to go on a field study (on the playground or other safe place) to search for rocks of each type.  
Allow partners to select rocks from a “stockpile” so that each pair of students has several specimens with which to work.  
Direct older students to explain to their partners the rock cycle and three types of rocks.  
Direct older students to allow younger partner to draw and label the rock cycle and describe the three kinds of rocks produced in each phase of the cycle.  
Have older students use guiding questions to help their younger partners identify, mount, and label their rocks in their boxes for display.  
Have partners team up with another pair and discuss their rock boxes giving reasons for classification.

## Six Trait Writing Rubric

Elements	Levels of Quality		
	Excellent	Developing	Underdeveloped
<b>Ideas and Content</b>	<p>Ideas and content are addressed by</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Providing clear and easily identifiable purpose and main ideas</li> <li><input type="checkbox"/> Providing relevant and specific supporting details</li> <li><input type="checkbox"/> Providing well-chosen content and selected details that consider audience and purpose</li> </ul>	<p>Ideas and content are addressed by</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Providing purpose and main ideas</li> <li><input type="checkbox"/> Providing supporting details, although they may be overly general and limited in places</li> <li><input type="checkbox"/> Providing content and selected details that consider audience and purpose, although they may not be consistently well-chosen</li> </ul>	<p>Ideas and content</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Do not provide clear purpose and main ideas</li> <li><input type="checkbox"/> Only provide supporting details that are overly general and limited</li> <li><input type="checkbox"/> Fail to provide content and selected details that consider audience and purpose; those present are not well chosen</li> </ul>
<b>Organization</b>	<p>Organization is addressed by</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> developing a clearly sequenced body that contains easily identifiable main topics and supporting details about the topics</li> <li><input type="checkbox"/> developing an obvious beginning that introduces the audience to the topic</li> <li><input type="checkbox"/> developing an obvious conclusion (end) that summarizes or retells the main topics</li> <li><input type="checkbox"/> containing numerous transitions identified by transitional words and phrases (e.g., first, then, finally, also, as a result, etc.)</li> </ul>	<p>Organization is addressed by</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> developing a sequenced body that contains identifiable main topics and supporting details about the topics</li> <li><input type="checkbox"/> developing a beginning that introduces the audience to the topic</li> <li><input type="checkbox"/> developing a conclusion (end) that summarizes or retells the main topics</li> <li><input type="checkbox"/> containing some transitions identified by transitional words (e.g., first, then, finally, also, etc.)</li> </ul>	<p>Organization is questionable because</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> the sequence of the body that does not contain identifiable main topics and supporting details about the topics</li> <li><input type="checkbox"/> the beginning is difficult to understand; the audience is not well-introduced to the topic</li> <li><input type="checkbox"/> the conclusion (end) is unclear because it either does not summarize or retell the main topics.</li> <li><input type="checkbox"/> there are few to no transitions identified by transitional words (e.g., first, then, finally, also, etc.)</li> </ul>

### Six Trait Writing Rubric (continued)

Elements	Levels of Quality		
	Excellent	Developing	Underdeveloped
<b>Voice</b>	<p>Voice is clearly shown in the writing by</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> consistently conveying a sense of involvement with the topic</li> <li><input type="checkbox"/> using a tone throughout the work that matches the purpose and the audience</li> <li><input type="checkbox"/> including originality, liveliness, humor or suspense throughout the work</li> <li><input type="checkbox"/> clearly conveying that this is “writing to be read.”</li> </ul>	<p>Voice is shown in the writing by</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> conveying a sense of involvement with the topic most of the time</li> <li><input type="checkbox"/> using a tone that usually matches the purpose and the audience</li> <li><input type="checkbox"/> including originality, liveliness, humor or suspense throughout most of the work</li> <li><input type="checkbox"/> conveying that this is “writing to be read.”</li> </ul>	<p>Voice is unclear in the writing because</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> a sense of involvement with the topic is not evident most of the time</li> <li><input type="checkbox"/> the tone usually does not match the purpose or the audience</li> <li><input type="checkbox"/> originality, liveliness, humor or suspense is lacking throughout most of the work</li> <li><input type="checkbox"/> often does not convey that this is “writing to be read.”</li> </ul>
<b>Word Choice</b>	<p>Word choice is shown by</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> the use of words that effectively communicate the main idea and paint a picture in the reader’s mind</li> <li><input type="checkbox"/> the use of a large variety of words that fit the topic, audience, and purpose well</li> <li><input type="checkbox"/> the use of new vocabulary or the use of everyday words in sophisticated and appropriate ways</li> <li><input type="checkbox"/> a lack of reliance on slang and clichés</li> </ul>	<p>Word choice is shown by</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> the use of words that communicate the main idea and often paint a picture in the reader’s mind</li> <li><input type="checkbox"/> the use of a variety of words that fit the topic, audience, and purpose</li> <li><input type="checkbox"/> the use of new vocabulary or the use of everyday words in new ways</li> <li><input type="checkbox"/> a lack of reliance on slang and clichés throughout most of the work</li> </ul>	<p>Word choice is shown by</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> the use of words that often fail to communicate the main idea and seldom paint a picture in the reader’s mind</li> <li><input type="checkbox"/> the use of little variety in words or words that do not fit the topic, audience, and purpose</li> <li><input type="checkbox"/> the use of little new vocabulary or reliance on everyday words</li> <li><input type="checkbox"/> a reliance on slang and clichés throughout most of the work</li> </ul>

### Six Trait Writing Rubric (continued)

Elements	Levels of Quality		
	Excellent	Developing	Underdeveloped
<b>Sentence Fluency</b>	<p>Sentence fluency is demonstrated by</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> the consistently correct use of simple sentences</li> <li><input type="checkbox"/> the successful attempt to use compound and complex sentences frequently and correctly</li> <li><input type="checkbox"/> the successful attempt to vary sentence length and beginnings frequently and correctly</li> <li><input type="checkbox"/> the use of sentences that flow together and sound natural (not choppy) throughout the work</li> </ul>	<p>Sentence fluency is demonstrated by</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> the correct use of simple sentences in most of the work</li> <li><input type="checkbox"/> the attempt to use compound or complex sentences correctly</li> <li><input type="checkbox"/> the attempt to vary sentence length and beginnings correctly</li> <li><input type="checkbox"/> the use of sentences that flow together and sound natural (not choppy) sometimes in the work</li> </ul>	<p>Sentence fluency is questionable because of</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> the frequent incorrect use of simple sentences</li> <li><input type="checkbox"/> the lack of an attempt to use compound or complex sentences; those present are incorrect most of the time</li> <li><input type="checkbox"/> the lack of an attempt to vary sentence length and beginnings or the incorrect use of sentence length and beginnings</li> <li><input type="checkbox"/> the frequent use of choppy sentences that do not flow together and sound natural in much of the work</li> </ul>

## Six Trait Writing Rubric (continued)

Elements	Levels of Quality		
	Excellent	Developing	Underdeveloped
<b>Mechanics</b>	<p>GRAMMAR AND USAGE</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> consistent control of subject/verb agreement</li> <li><input type="checkbox"/> correct verb tense</li> <li><input type="checkbox"/> consistent point of view (first, second, or third person)</li> </ul> <p>PUNCTUATION</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> correct end of sentence punctuation throughout the work</li> <li><input type="checkbox"/> correctly placed commas in dates, in a series, after introductory words, and with phrases throughout the work</li> <li><input type="checkbox"/> apostrophes consistently used correctly in contractions and singular possessives</li> </ul> <p>SPELLING</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> few to no spelling errors in common words appropriate to grade level; if present, not distracting</li> <li><input type="checkbox"/> few to no incorrectly spelled difficult or unfamiliar words; if present, not distracting</li> </ul> <p>CAPITALIZATION</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> consistently correctly capitalized sentence beginnings, proper nouns, titles, abbreviations and the pronoun <i>I</i></li> </ul> <p>PARAGRAPHING</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> successful attempts at paragraphing throughout the work</li> </ul>	<p>GRAMMAR AND USAGE</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> control of subject/verb agreement throughout most of the work</li> <li><input type="checkbox"/> correct verb tense in most cases</li> <li><input type="checkbox"/> generally consistent point of view (first, second, or third person)</li> </ul> <p>PUNCTUATION</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> correct end of sentence punctuation throughout the work</li> <li><input type="checkbox"/> correctly placed commas in dates, in a series, after introductory words, and with phrases in most of the work</li> <li><input type="checkbox"/> apostrophes generally used correctly in contractions and singular possessives</li> </ul> <p>SPELLING</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> few to no spelling errors in common words appropriate to grade level</li> <li><input type="checkbox"/> few to no incorrectly spelled difficult or unfamiliar words</li> </ul> <p>CAPITALIZATION</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> correctly capitalized sentence beginnings, proper nouns, titles, abbreviations and the pronoun <i>I</i> in most of the work</li> </ul> <p>PARAGRAPHING</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> successful attempts at paragraphing in some of the work</li> </ul>	<p>GRAMMAR AND USAGE</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> control of subject/verb agreement lacking in most of the work</li> <li><input type="checkbox"/> correct verb tense in few cases</li> <li><input type="checkbox"/> generally inconsistent point of view (first, second, or third person)</li> </ul> <p>PUNCTUATION</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> correct end of sentence punctuation in little of the work</li> <li><input type="checkbox"/> correctly placed commas in dates, in a series, after introductory words, and with phrases in little of the work</li> <li><input type="checkbox"/> apostrophes often used incorrectly in contractions and singular possessives</li> </ul> <p>SPELLING</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> frequent spelling errors in common words appropriate to grade level</li> <li><input type="checkbox"/> frequent incorrectly spelled difficult or unfamiliar words</li> </ul> <p>CAPITALIZATION</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> incorrectly capitalized sentence beginnings, proper nouns, titles, abbreviations and the pronoun <i>I</i> in most of the work</li> </ul> <p>PARAGRAPHING</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> unsuccessful attempts at paragraphing throughout the work</li> </ul>

### Evaluation Form for Written Report

Writer's Name \_\_\_\_\_ Date \_\_\_\_\_

Evaluator's Name \_\_\_\_\_

Please use the Report Rubric as a guide when you evaluate the written report. Select the level of quality for each part of the report and in the blank below the level, provide at least two pieces of evidence to support your evaluation.

Elements	Levels of Quality		
	Excellent	Developing	Underdeveloped
Ideas and Content			
Organization			

**Evaluation Form for Written Report (continued)**

<b>Elements</b>	<b>Levels of Quality</b>		
	<b>Excellent</b>	<b>Developing</b>	<b>Underdeveloped</b>
<b>Voice</b>			
<b>Word Choice</b>			

**Evaluation Form for Written Report (continued)**

<b>Elements</b>	<b>Levels of Quality</b>		
	<b>Excellent</b>	<b>Developing</b>	<b>Underdeveloped</b>
<b>Sentence Fluency</b>			

**Evaluation Form for Written Report (continued)**

Elements	Levels of Quality		
	Excellent	Developing	Underdeveloped
<b>Mechanics</b>	GRAMMAR AND USAGE	GRAMMAR AND USAGE	GRAMMAR AND USAGE
	PUNCTUATION	PUNCTUATION	PUNCTUATION
	SPELLING	SPELLING	SPELLING
	CAPITALIZATION	CAPITALIZATION	CAPITALIZATION
	PARAGRAPHING	PARAGRAPHING	PARAGRAPHING

## Resources and References

### **Books, Booklets, Pamphlets, Newspapers**

- Bates, Robert L. and Julia A. Jackson. *Dictionary of Geological Terms*. New York: Doubleday, 1984.
- Canty, J. Michael and Michael N. Greeley, eds. *The History of Mining in Arizona*. Tucson: Mining Club of the Southwest Foundation, 1987 (vol. 1), 1991 (vol.2) 1999 (vol. 3).
- Copper Facts*. New York: Copper Development Association, Inc., 1998-99.
- Farndon, John. *How the Earth Works*. Pleasantville: Reader's Digest Association, 1992.
- Fuller, Sue. *Rocks and Minerals*. London: Dorling Kindersley Publishing, Inc., 1995.
- Geology The Active Earth*. National Wildlife Federation. New York: McGraw-Hill, 1997.
- Leaming, George F. *The Story of Mining in Bisbee*. Free Geos Library, 1998.
- Lichtenhan, Gail. *Copper the Mighty Metal Arizona's Gift to the World*. Arizona Mining Association. Phoenix: Alphagraphics, 2001.
- McBride, James. *The Mission, Means, and Memories of Arizona Miners*. Arizona Mining Association. Phoenix: Qwest Creative, Inc., 1997.
- The Mining Industry and Minerals*. Salt Lake City: National Energy Foundation, 1994.
- Parker, Steve. *Rocks and Minerals*. London: Dorling Kindersley Publishing, Inc., 1993.
- Pellant, Chris. *Rocks and Minerals*. London: Dorling Kindersley Publishing, Inc., 1992.
- Staedter, Tracy. *Reader's Digest Pathfinders Rocks and Minerals*. Sydney: Weldon Owen, Inc., 1999.
- Walker, Henry P. and Don Bufkin. *Historical Atlas of Arizona*. Norman: University of Oklahoma Press, 1986.
- Williams, Jack. *From the Ground Up*. Douglas: Phelps Dodge Corporation, 1981.
- Zike, Dinah. *The Earth Science Book*. New York: John Wiley and Sons, Inc., 1993.

### **Maps**

- Simkin, Tom, and others. *This Dynamic Planet*. Washington, D.C.: Smithsonian Institution, 1994.
- Kamilli, Robert J. and Stephen M. Richard, eds. *Geologic Highway Map of Arizona*. Tucson: Arizona Geological Society and Arizona Geological Survey, 1988.
- Active Mines in Arizona — 2000*. Phoenix: Arizona Department of Mines and Mineral Resources, 2001.

## **Videos**

“Bisbee — The Copper Queen City” video from *Copperstate Chronicles* (School Library or Arizona Mining Association’s Video Lending Library) (20 minutes)

*Los Mineros*. PBS American Experience Presentation. Galan Productions, Inc., 1991. (50+ minutes)

*The Rock Cycle*. Fort Collins: Scott Resources, Inc., 1990. (18 minutes)

*Rocks and Minerals. Science in Action*. Venice: TMW Media Group, 1994. (18 minutes)

*Plate Tectonics: The Puzzle of the Continents*. Fort Collins: Scott Resources, Inc., 1990. (18 minutes)

## **Other Resources and References**

*From Mountains to Metals: The Story of Rocks, Minerals, and the Mining Industry*. (National Energy Foundation, 1995. (poster)

Leaming, George F. *The History of Mining in Bisbee*. Free Geos Library, 1988. (Timeline poster)

*Look Around: Everything is Made from Something*. (Mineral Information Institute, 1994. (poster)

*Rocks and Minerals and How We Use Them*. (National Energy Foundation, 1991. (poster)

*Visualizing Earth’s Processes*. NeoSCI. (poster)

Arizona Mining Association

[www.azcu.org](http://www.azcu.org)

ASARCO Mineral Discovery Center

[www.mineraleDiscovery.com](http://www.mineraleDiscovery.com)

Arizona Department of Mines and Mineral Resources

[www.admmr.state.az.us](http://www.admmr.state.az.us)

Arizona Geological Survey

[www.azgs.state.az.us](http://www.azgs.state.az.us)

Arizona Mining Association, 141 E. Palm Lane, Suite 100, Phoenix, AZ 85004-1554,  
Ph. (602) 266-4416

Arizona Mining and Mineral Museum, 1502 West Washington, Phoenix, AZ 85007  
Ph. (602) 255-3791

ASARCO Mineral Discovery Center, 1421 W. Pima Mine Road, Sahuarita, AZ 85629,  
Ph. (520) 625-7513

Arizona Geological Survey, 416 W. Congress, Suite 100, Tucson, AZ 85701,  
Ph. (520) 770-3500