

## HARD-ROCK CAFÉ

*(offering a delectable array of culinary choices for the discerning student)*

### STANDARDS

See summary of National Science Education Standards.

Original: <http://books.nap.edu/readingroom/books/nse/>

Standard Concept	General Standard	Specific Standard	General Standard	Specific Standard	General Standard	Specific Standard
Grade Level		K-4		5-8		9-12
Science as Inquiry A	Abilities ... to do ... inquiry	A.1.4.1	Abilities ... to do ... inquiry	A.1.8.1	Abilities ... to do ... inquiry	A.1.12.1
		A.1.4.2		A.1.8.2		A.1.12.2
		A.1.4.3		A.1.8.3		A.1.12.6
		A.1.4.5		A.1.8.4		
				A.1.8.6		
				A.1.8.7		
	Understandings about ... inquiry	A.2.4.1	Understandings about ... inquiry	A.2.8.1	Understandings about ... inquiry	A.2.12.2
		A.2.4.2		A.2.8.4		
		A.2.4.3				
		A.2.4.4				
		A.2.4.5				
		A.2.4.6				
Physical Science B	Properties of ... materials	B.1.4.1				
		B.1.4.2				
Earth Science D	Properties of Earth Materials	D.1.4.1	Structure of the Earth System	D.1.8.4		



## **HARD-ROCK CAFÉ**

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### **INTRODUCTION**

Rocks occur in various compositions and textures. Scientists need to organize or classify the types of rocks in order to make comparisons and interpretations.

### **OBJECTIVE**

Students will devise classification schemes for rocks based on observations, measurements, and recording of compositional and textural variations among different rock samples.

### **THE ACTIVITY**

#### **MATERIALS**

- An assortment of a dozen or more rock samples including several examples of each major rock type.
  - One identical collection should be available for each group of students working together
- One large (24"x 36") sheet of paper for each group of students
- Any tools you have available for students to use in making measurements or investigations- metric ruler with millimeters,
- Piece of metal, such as a large nail, for scratching rocks and for hitting against rocks to listen to the sound made - (hammers are not advised, for safety reasons)
- Scale (although hands are useful in determining relative weights of two rocks)
- Magnifying glasses
- Pencils

#### **ADVANCE PREPARATION**

- 1) Gather an assortment of a dozen or more unlabelled rock samples including several examples of each major rock type.
  - a) Samples should be large enough to adequately illustrate significant textural features such as bedding or foliation (usually fist-sized) and should have clean, unweathered surfaces.
  - b) Ideally, the collection should include
    - i) coarse- and fine-grained rocks (granite, rhyolite, basalt, gabbro),
    - ii) glasses, such as obsidian and pumice,
    - iii) bedded sedimentary rocks such as shale,
    - iv) sandstone,
    - v) fossiliferous limestone,
    - vi) slate,
    - vii) schist,
    - viii) gneiss,
    - ix) some fragmental rocks such as tuff, breccia, conglomerate.



- 2) Nearly any collection of rocks could be used, however, assuming there are discernible differences in texture and mineralogy.

## PROCEDURE

- 1) Divide class into as many groups of students as you have collections of rocks.
- 2) Give each group of students a collection of rocks in the center of large paper.
  - a) Have each student first list all physical properties he or she can think of that might be used to differentiate among the rocks.
  - b) If necessary, guide them in discussion toward sensory examination
    - i) Visual characteristics - color, grain size, layering;
    - ii) "Touch" characteristics - smoothness, relative weight; smell (some sedimentary rocks have an "earthy" smell)
    - iii) Sound (does the rock make a "clink" or "clunk" sound when struck by a metal object?)
- 3) When each student has made a list of properties, have students merge their lists into a group list and ask each group for a report on the properties they recognize, consolidating them on the board into broad textural and compositional categories.
  - a) Guide them to fill in any areas which they may not have recognized.
- 4) Have students compare and contrast rocks on the basis of the properties identified or measured
  - a) Light-colored rocks and dark-colored rocks
  - b) "Heavy" rocks and "light" rocks (density)
  - c) Easy or difficult to scratch with nail (hardness)
  - d) Visible component grains or "invisible" component grains
  - e) Texture of the component grains
    - i) Angular, or rounded
  - f) Layering or massive (no layering)
  - g) Shiny or dull.
  - h) Does the rock have holes or not?
  - i) Do the grains fit together like a puzzle?
  - j) Do the rocks sound different?
  - k) How do they look with the magnifying glass?
  - l) Have the students collaborate on arranging or sorting the collection on the basis of several of the different properties described and check to make sure the members of each group are carefully using their powers of observation to arrive at similar arrangements.
- 5) Students' observations and groupings of similar and dissimilar rocks can then be used as a jumping-off point for a discussion of earth processes that form each of the different rock types
  - a) Volcanism
  - b) Erosion and deposition
  - c) Metamorphism
  - d) Melting and crystallization.
- 6) Each group should collaborate on preparing a recipe for one or more of the rocks as if it were a food, describing both the ingredients (composition) and preparation and cooking instructions (to get texture) for each sample.



- a) The students can also prepare a “menu” for their “hard rock café” describing each rock as a menu item using the properties identified in the exercise and their imagination and creativity with regard to the nutritional content, texture, attractiveness, etc. of their menu items.
- b) Members of each group should read their recipes (and/or menu item descriptions) aloud to other groups who should be able to identify the rock being described.

## OPTIONS

- 1) You may want to follow this discussion with a “guessing game” where you tell them the name of one of their rocks and begin describing its properties one by one, having them arrive at the sample in their collection by the process of eliminating ones that do not fit the characteristics described.
- 2) Another follow-up activity is for each student to invent a new name for one of the rocks in the collection and to write his or her reasons for naming it that.
- 3) Students can write (and draw) descriptions of one rock in the collection and exchange the cards with students at another table in another group and have those students find the rock described on the card.

## TEACHER NOTES

### CONTENT FOCUS

As an inquiry-based investigation of earth materials of varying types, this activity leads students to make careful observations of physical characteristics of a variety of rocks and to devise multiple possible classification schemes based on similarities and differences observed and recorded. Students should use (or discuss reasons for NOT using) all their senses in determining the physical properties of the rocks. (Tasting the rocks, although potentially instructive, should be discouraged for health and safety reasons).

Traditional teaching of a unit on rocks and geology has generally involved an initial discussion of the three basic rock types, igneous, sedimentary, and metamorphic, and the rock cycle of crystallization, erosion, deposition, compaction, metamorphism, melting, etc. This is typically followed by detailed discussions of the geologic processes of formation of each of these rock types, subdivisions of each rock type, and examples of each, finally working into identification of each individual rock by deducing from its texture and composition the processes which probably formed it.

While the validity of the factual material in this scheme is not questioned, the process is here inverted, giving the students the opportunity first to observe the variety of rocks present, and then to devise their own questions about what components make up the rocks and how those components are structured, and to postulate possible natural conditions under which such compositions and textures might evolve. This approach allows the students to fully involve themselves in the process of scientific inquiry, much as early geoscientists did when examining the earth’s great variety of rocks without the benefit of someone else’s classification scheme imposed upon them from the beginning. Their observations and groupings of similar and dissimilar rocks can then be



used as a jumping-off point for a discussion of the earth processes that form each of the different rock types and related activities to illustrate these processes.

