How Is This Module Organized?

This module is written as an educator guide. This approach makes it possible to give it a conceptual and pedagogical structure while still providing educators the flexibility to tailor the activities to the needs of their classes. The educator guide prepares educators to conduct classes around core questions, and it outlines investigations that explore those questions.
How Is This Module Organized?

Teaching Pointers
To assist you in conducting hands-on, inquiry-based activities, you will find pointers, classroom management strategies, discussion suggestions, extensions, and answers to the questions presented throughout the module.

Assessment Suggestions
This module outlines several options for assessing students, including preassessment questions, question sets, case studies, and suggestions for alternate ways of exhibiting student understanding.

Activity 1

Procedure to Test Students' Preconceived Ideas
1. Present the problem, "How hot can you heat water?" and as a class discuss how to control variables such as the amount of water, the number of burners, the height of the rings, etc.
2. Consider using 100–150 milliliters of water because it: (a) is easy to measure; (b) comes to a boil in 5–8 minutes; (c) does not boil away during a class period; (d) does not make too big a mess if spilled; (e) will not burn as badly as larger amounts of water if spilled on the skin; and (f) will not cover the thermometer bulb. Make sure to read the safety notes on page 5 before beginning the activity.
3. Have student teams set up the equipment for the activity (Figure 1.3):
   - Measure the agreed-upon amount of water
   - If using Bunsen or alcohol burners, adjust the lower ring to fit the burner properly and set a wire gauze on the lower ring
   - Place the beaker or flask containing the water on the wire gauze or on the hot plate (turned off)
   - Attach the thermometer above the beaker with a clamp or string
   - Adjust the thermometer so that the thermometer bulb is completely submerged and just above the bottom of the beaker (So it can measure the water temperature rather than the temperature of the glass, it should not touch the bottom of the beaker.)
4. Have students take the starting water temperature.
   - Teams of two students work well because there is little opportunity for off-task behavior when each student is totally engaged monitoring the time and temperature.
5. After you check each group's setup, have students either light their burners or switch on their hot plates.
6. Using a stirring rod (not the thermometer), have students stir and record the water temperature every 15 seconds.
   - Hitting a temperature plateau is a surprise that challenges students' intuition. Thus, the activity becomes a rich experience upon which to challenge old ideas and to develop new understandings. At some point between 97 and 105 degrees Celsius (depending on the weather and your elevation), students find that the temperature no longer changes. The crucial element is the discovery that, although the burner still puts in heat, the temperature stops rising. Do not let on that this is the result students are meant to achieve.

Activity 6

MARS PATHFINDER LANDER Temperature at 0.75 meters height

MARS PATHFINDER LANDER Surface Pressure

Technology and Internet Recommendations
Computers and the Web can give students access to a rich set of support materials. The module lists pertinent Web sites, CD-ROMs, and videos and how to get actual Martian data and images. However, this module does not require the use of any classroom technology.

Case Study
Each activity in this module provides some of the information needed to answer the question: Is there water on Mars? In Activity 6, students take a position on this question and apply and integrate the module's concepts. This synthesis can be used as an assessment.