Discussion & Reflection

1. Discuss results with students. Was it what they expected, what was their final cost-efficiency (expressed in terms of the percentage of energy blocked by the sunshade versus the cost of the sunshade, %/$, on Page 4 of Student Worksheet 2), whose design was the most cost-efficient, what materials did they use, etc.

2. Remind the students of the heat curve of water, and ask how that is important to the experiment. How would the experiment be affected if phase changes did not occur this way?

3. Discuss with students the possible sources of error in the setup of the experiment and modifications they may have made for the setup on Student Worksheet 2. If they want to re-do their experiments, encourage them to do so. Later they can compare whether their cost-efficiency improved as a result. (Since a control can is used in both cases to take errors into account, the change should not be significant if the sunshade design is efficient.) Discuss the importance of understanding sources of errors in scientific experiments and the need to improve designs and repeat experiments as errors are discovered.

4. Remind the students of the idea of passive versus active cooling, and relate it to the concept of shadows. Discuss with students the idea of shadows creating night-time on planets, and the resulting change in temperature between night and day. Discuss how atmospheres play a role in distributing and balancing night and day temperatures.

5. Discuss the MESSENGER mission to Mercury and why it needs a sunshade. Hand out the MESSENGER Information Sheet (if you have not done so already). You can have the students consider the MESSENGER mission in greater detail by giving them an Internet research project to examine the passive cooling methods used by the MESSENGER mission designers. You can instruct the students to pay special attention to the design of the sunshade and what kind of materials are used in its construction, as well as what is known about the possibility of ice in the shaded craters in Mercury's polar regions.