Inquiry and Design in the Classroom

The Materials World Modules give you a unique format for integrating inquiry-based learning and design-centered projects in science and math classes. The tips below can help you use the modules to the fullest potential in your classroom.

Inquiry in the Classroom

Inquiry-based teaching involves students in identifying questions and using laboratory investigations to answer those questions. You may already use many inquiry-based techniques in your classroom. For teachers interested in expanding on this approach, this section outlines suggestions for increasing students' experience with inquiry-based science.

Encourage students to ask questions. Questions are the foundation of inquiry-based learning. The Activities and Design Projects include guiding questions that can spur students' inquiry. They appear in the gray box near the beginning of each Activity or Design Project. Students are also encouraged to generate their own questions in the I Wonder section at the end of each Activity.

Help students search for answers to their own questions, rather than trying to give them answers. Leaving questions unanswered can spur students to plan an investigation to help find an answer. Whenever possible, encourage students to carry out such investigations and report their findings to the class.

You may find that students ask questions to which you do not know the answers. This is a great opportunity to point out that science is a process of seeking answers to questions, not a state of knowing all the answers. Some of the quotes that appear in the margins of the Student Edition illustrate this idea. Such quotes can be used to stimulate discussion or to inspire students as they work on the module.

Emphasize explanations and evidence during discussion. Model logical reasoning and present evidence for why you consider a particular explanation to be true. Allow students to challenge your explanations and question your evidence. Encourage them to look at all evidence with a critical eye. Have them assess their investigations for sources of experimental error. In these ways, you help students develop the tools they need to present evidence and engage in increasingly complex analytical discussions.

Design in the Classroom

In the Design Projects of the Materials World Modules, students follow a process of iterative design, shown in the diagram. Through this process, students learn something about their initial design and then apply what they have learned as they work on a redesigned product. If time is too short for a full redesign phase, encourage students to think about and discuss an improved design. Aside from simulating the work processes of many scientists and engineers, the iterative process of the Design Projects helps students apply science concepts in a unique and exciting way. The suggestions on this and the facing page can help you use the Design Projects to their fullest potential.

Successful Designs

Although the Design Projects can be arenas for competition, students are likely to learn the most when the projects are set up to allow everyone to succeed. A set of reachable performance goals can be established for any Design Project. Some groups will produce designs that exceed these performance goals; other groups may produce designs that just meet the goals but offer other benefits such as incorporating low-cost materials or being easy to construct. Emphasize that all designs that meet the performance goals are successful. Each group of students can then present the particular benefits of their design.

Learning from the Design Process

In working on the Design Projects, students should not just focus on producing a successful design. They should also strive to understand how and why their design meets the stated goals and to show the rest of the class why their particular design is a good one. You can help students learn from the Design Projects by reinforcing these objectives.

There are several other ways you can promote learning as students engage in the design process. First, you may wish to have students focus on experimentation when they work on the initial design and then have only the redesigned product subject to the formal design challenge or contest. This frees students to explore, because they won't be penalized if their initial design doesn't perform well. Second, encourage students to share ideas. Give students an opportunity to communicate the results from their initial designs before final designs are built. This lets students reflect on other groups' designs as well as their own. Students may draw on another group's idea to come up with a modification of their first design. The more ideas students are exposed to, the more new ideas they will discover.

Designing for the Real World

Real-world designs are often a compromise of performance and cost, wrapped in a package that will appeal to the consumer. When students work on the Design Projects, they can incorporate such design constraints as cost, ease of construction, durability, environmental impact, and customer appeal. For their final report or presentation, they can prepare advertising campaigns or marketing plans for their products, or suggest new markets and new applications for the products that they designed. Margin notes in the Teacher's Edition (often labeled Portfolio Projects) give suggestions on how to incorporate such real-world issues into the Design Projects.

The Design Process

Because the design process is iterative, students get to apply what they learn in real and satisfying ways.