Time Frame

Teacher Preparation ..... 45 minutes

Activity 1: Lab Investigation ..... 45–60 minutes

Activity 2: Scientific Convention ..... 45–60 minutes

Activity 3: Spacecraft Design ..... 2 sessions, 45-60 minutes each

Activity 4: What Scientists Do ..... 20–30 minutes

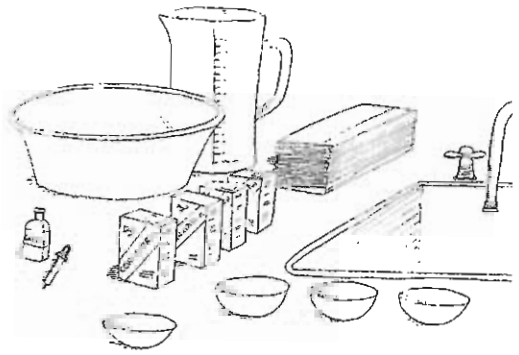
Optional: Microscope Eyes ..... 45–60 minutes

Optional: Full Investigations ..... 3–6 sessions, 45-60 minutes each

The above are guidelines to help give you a sense of how long the activities may take. The sessions may take less or more time with your class, depending on students' prior knowledge, their skills and abilities, the length of your class periods, your teaching style, and other factors. Try to build flexibility into your schedule so that you can extend the number of class sessions if necessary. In particular, the length and number of sessions for the optional "Full Investigations" activities will vary considerably, depending on your class and the parameters of their investigations.

In the late 1990s, the *GEMS Network News* print version (now the eNetwork News) encouraged teachers and students to see if they could "dance on Oobleck." Many responded, along with proposed explanations. For a humorous look at this subject, check out http://www.youtube.com/watch?v=f2XQ97XHjVw

What You Need for the Whole Unit



For the class:

- ☐ lots of old newspapers
- ☐ 1 roll of masking tape
- ☐ 1 small squeeze bottle of green food coloring *
- ☐ 1 extra 16-oz. box of cornstarch
- ☐ 1 measuring cup (1–4 cup capacity)
- ☐ 1 large mixing bowl or small bucket (6–8 liters)
- ☐ water
- ☐ paper towels
- ☐ markers or chalk for whiteboard or chalkboard
- ☐ whiteboard, chalkboard, or overhead projector
- ☐ overhead transparencies of Mars exploration, pages 40–44
- ☐ *(optional, but highly recommended)* selection of small wood, paper, plastic, Styrofoam, and metal items (e.g., toothpicks, popsicle sticks, plastic utensils, packing "peanuts," small paper cups, paper clips, straws, etc.)
- ☐ *(optional)* hot plate and saucepan

* *You'll also need a medicine dropper if the food coloring is not in a squeeze bottle.*

Quantities are based on a class size of 32 students. Please also refer to the "What You Need" and "Getting Ready" sections for each activity. Options for gathering materials for this unit:

- *Some teachers prefer to gather materials needed to teach a GEMS unit themselves at local stores.*
- *Others prefer to purchase a ready-made GEMS Kit®.*

For more information on GEMS Kits, visit the web at lhsgems.org/gemskits.html or contact GEMS.

For each team of 4–6 students:

- ☐ 1 deep plastic bowl (at least two quarts)
- ☐ 1 box of cornstarch (16 oz.)
- ☐ 1 felt-tipped marker or crayon
- ☐ 2 large sheets of paper (at least 16" x 20") or at least 10 sentence strips

Note Although pie pans may appear in older photographs for this guide, plastic bowls work well and are more durable. Plastic bowls are used in the Oobleck GEMS Kit.

For the optional Microscope Eyes activity you will also need:

For the class:

- ❑ Two clear containers filled with at least 2 cups of water. All students in the class should be able to easily see them.
- ❑ sugar
- ❑ stirrer
- ❑ spoon
- ❑ overhead transparencies of pages 52–54

For each student:

- ❑ Microscope Eyes worksheet

INTRODUCTION

Oobleck—even the name of this mysterious substance conjures up strange sensations. Oobleck is always a surprise. Watch it flow like a liquid, then feel its surface resist your fingers like a solid!

Since its first use in science education activities in the early 1970s, the mixture of cornstarch, water, and food coloring that we call Oobleck has been used in diverse ways by many different programs and teachers, although sometimes in a superficial way. Through many years of presentation of the GEMS unit, we've found that investigating Oobleck can be much more than having fun with a weird substance. When implemented in a coherent and carefully thought out sequence, Oobleck can be a tremendous vehicle for building conceptual understanding of key standards-based science content and inquiry.

The significant subtitle of this guide, *What Do Scientists Do?* indicates that we take advantage of the high interest and excitement that Oobleck inspires to develop important abilities related to the methods and art of scientific investigation, and to deepen student understanding of the nature of science as they experience the following:

- the excitement of exploration and discovery of a fascinating substance.
- refining ideas about the distinction between a solid and a liquid as they confront a substance that does not "follow the rules."
- the challenge of composing and refining a scientific statement.
- applying their understandings to a technological challenge, as they design spacecraft that can land on an ocean of Oobleck.
- seeing the technological innovations employed by actual Mars exploration scientists, and how they have demonstrated the nature of science in their explorations.
- reflecting on the skills and processes of being a scientist that they employed throughout the unit.

If the two optional activities are presented, students also benefit from:

- attempting to explain the properties of Oobleck by designing a model of what is going on at the molecular level.
- designing and conducting their own full inquiries to probe further questions they have about Oobleck.

As a GEMS workshop presenter prepared to present Oobleck to a group of teachers, one teacher opprooched and said, "Oh, I already know Oobleck. I've done it." It turned out she had done a versian of Oobleck from another curriculum project. The GEMS workshop presenter suggested she participote anyway, and see what she thought. After the workshop the same teacher exclaimed, "This is so much deeper than what I've seen done with Oobleck before. I had no idea you could teach so much with it!"

One of the most appealing aspects of Oobleck is that it is not fully understood, even by scientists. This provides an authenticity to student investigations and their attempts to explain its strange properties. It also makes for a flexible unit that can be taught at a variety of grade levels. With modifications, Oobleck can be the catalyst for inspired debate with students from kindergarten through adults. In fact, it's often smilingly said that "Oobleck seeks its own level."

This well-known and widely used GEMS unit on the nature of science is often used to launch a year's science curriculum. Others use Oobleck to begin a unit on matter or a series on astronomy. The unit has always been distinguished by a learning cycle-based sequence, which includes opportunities for students to begin with an investigation, then reflect on their experiences, refine their conclusions through classroom debate and discourse, and apply what they learn in a different setting. And all of this in a relatively short and highly motivating unit!

The earlier editions of this guide included a poster about the Mars Viking mission. If you have the poster, it could also be displayed when students discuss how they acted like scientists during Activity 4.

Be on the lookout for future Mars missions. As this edition goes to press NASA's Phoenix Mars lander has just reached the red planet, and an ambitious new rover, called the Mars Science Laboratory, is scheduled to launch in 2009.

The original GEMS unit thus provided a solid platform for this new, significantly revised 21st century edition. We've updated the information on Mars missions, to feature the two Mars Rovers. Two optional sessions have been added, *Microscope Eyes* and *Full Investigations*. *Microscope Eyes* is an opportunity for students to devise their own molecular/structural models for the phenomena they've explored. In *Full Investigations* students design their own investigations to pursue questions they have about Oobleck. In addition, throughout the unit we've incorporated the additional tips and nuances we've picked up over many years of teaching these activities.

Like much of active inquiry-based science, especially when intriguing substances are involved, Oobleck poses some management and clean-up issues. Class management suggestions appear throughout the guide in the step-by-step instructions. Oobleck is messy, but it is much easier to clean up than might be expected. Please see "Tips on Cleaning Up Oobleck" on pages 11 and 12 for important information.