Industry Volunteer Guide

Welcome!

A World in Motion: The Design Experience, Challenge 1 is a dynamic curriculum focusing on the engineering design process. Volunteering in a classroom using this curriculum can be a highly rewarding experience for you, the students, and the teacher. Not only will you have fun working with young people in a hands-on activity, but you will find yourself inspired by the students' creativity and the fresh perspective they bring to engineering design. You will also have the satisfaction of contributing to and sharing in their discoveries and success—and you may even spark a new interest for some students.

Rationale and Goals of the Curriculum

The curriculum is a set of three challenges designed to provide students in grades 4–6 with an Engineering Design Experience, as well as promote an interest in mathematics, science, and technology by giving them opportunities to work with materials that embody scientific and technical phenomena. The challenge put forth in each of these experiences involves student design of a toy vehicle. Engaging scenarios provide a context in which students develop problem-solving, science, and math skills. As student design teams work to get their toy vehicles to meet specified performance criteria, they wrestle with authentic science and engineering problems.

An important focus is the quality of students' experience. Fostering positive attitudes toward science, mathematics, and technology is of major importance, as is encouraging a thoughtful approach to problem solving. Students are not required to master certain scientific concepts or mathematical methods, nor create a "winning" design. Instead, the objective is to facilitate the design of a variety of vehicles and help students understand what makes the vehicles perform differently.

A World in Motion: The Design Experience, Challenge 1 embodies the current national standards for teaching and learning. In particular, it meets the National Research Council standards to educate students to develop products and solutions to problems using technological design, and the National Council of Teachers of Mathematics standards emphasizing that students should see mathematical connections to the real world through mathematical thinking, modeling, and problem solving.

The Engineering Design Experience draws on the problem-solving process frequently used by engineers in design teams and taught at many engineering schools across the country. As students step through the process, they have ample opportunities to develop science and math skills. Below are activities specifically recommended in the national standards that are present throughout the challenges:

- Students explore materials and ideas.
- They ask questions.
- They propose their own explanations.
- They test their explanations.
- They communicate their ideas.

The Design Challenges

Student Challenges

A World in Motion: The Design Experience, Challenge 1 consists of three design challenges suitable for grades 4–6. Each challenge takes approximately 15 class periods of about 45 minutes each. If students work on the challenge five periods a week, a challenge will take about three weeks to complete.

Skimmer Challenge (Grade 4).

Students make paper sailboats that are propelled by fans and glide along the floor. They test the effect of different sail shapes, sizes, and construction methods on the performance of their skimmers. The goal of this challenge is to design a set of skimmers that reliably meet specific performance criteria. Friction, forces, and the effect of surface area are some of the physical phenomena students encounter in this challenge.

JetToy Challenge (Grade 5).

Students make balloon-powered toy cars. Their challenge is to design an appealing toy that performs in a specific way (travels far, carries weight, goes fast, etc.). Students experiment with different chassis designs and nozzle sizes to determine their effect on the JetToy's performance. Jet propulsion, friction, and air resistance are the core scientific concepts students explore in this challenge.

In each of the three challenges students are presented with a request from a fictitious toy company. They are given an interesting technology and an idea for using it in a build-it-yourself toy. Following the Engineering Design Process, students start by assembling a standard prototype and finish with their own customized toys.

The Engineering Design Experience

The curriculum presents the Engineering Design Experience in a manner that aligns with the engineering practices of the real world. The design process that students undertake includes the following five phases:

- **Set Goals.**
  Students are introduced to the challenge scenario. They review the toy company's letter, discuss what is requested of them, and share ideas about how to go about solving the problem. Students begin to work in teams and start recording work in design logs.

- **Build Knowledge.**
  Many activities are included in this phase as students develop the knowledge and skills they will need to design their own vehicles. The first thing students do is build a model and figure out how it works. In the next several activities teams vary factors on the model, record observations, and discuss results with the rest of the class. They move from simple explorations and opinions to controlled experiments and performance predictions based on graphs or tables of results.

- **Design.**
  Student teams design their own toy to meet the requirements stated in the toy company's letter. They determine the values of variables, plan construction, and predict performance based on knowledge from previous activities.

- **Build and Test.**
  Students build their design and test it to see how well it meets the performance criteria.

- **Present.**
  Student teams make presentations of their work to an audience.

Volunteering in the Classroom

Your Role as a Volunteer

A key element in *A World in Motion* is the use of industry volunteers in the classroom. Volunteers who are engineers are especially valuable as they can provide students with an awareness of the engineering profession as well as be a support for the teacher. Whether you can only visit the class once or twice, or you are able to visit more frequently, your presence in the classroom will make a difference to the class and improve the Engineering Design Experience for students.

Note that you are not being asked to demonstrate the scientific and technical expertise you have developed over the years. The exploratory nature of this experience requires that teachers and volunteers facilitate student learning by providing materials and presenting an engaging challenge. This approach takes more time, but it leaves students with a deep understanding and helps them develop the ability to frame questions and seek solutions.

General Guidelines for Volunteers

There are many ways volunteers can contribute. Simply by being present in the classroom, you will lend importance to the curriculum program and raise students' interest.

The following guidelines will help you be a comfortable and effective contributor.

- Let the teacher introduce you to the class. Give the teacher and students information that will let them get to know you as a person and as a professional.

- Invite students to ask you questions. Prime the pump, if necessary, by suggesting some questions that you think might interest them.

- Ask the teacher about the math and science level of the class so that you can speak at an appropriate level and not refer to concepts that will be unfamiliar to students. Also ask the teacher for general tips on how to talk effectively to students.

- Try to visit during the presentation of final designs. This event provides an opportunity for you to give students positive feedback and recognition for the work they have done. Having an audience of invited guests may also make the presentations more significant to the students.

Suggestions for Sharing Your Work

To help students put their challenges in the larger context of engineering, the teacher may ask you to do a short presentation on engineering at the beginning or end of the unit. Depending on your background and the needs of the particular teacher and students, you may want to do some of the following:

- Talk with the students about your professional work. Bring demonstrations, pictures, or samples of your work, if possible.

- Relate what they are doing to what an engineer (or science professional) actually does. Help students recognize that an engineer's work is highly creative and that an engineer draws upon information from math, science, and other fields in order to create a good design.

- Discuss how teamwork is important in today's work environment. Give examples of how members of a design team often have different backgrounds, and how they are all important in making a design successful.

- Discuss the importance of keeping design logs and documenting all efforts, whether or not they are successful. If appropriate, bring in examples of the kinds of records you keep of the work you do.

- Describe some of the work that goes into successful designs, such as research, testing, prototyping, and creative thinking.

- Discuss how design specifications and drawings are used. Show examples from your own work, if appropriate.

- Discuss the value of testing and revising designs to make sure they are successful.

Suggestions for Supporting Students' Work

You can have a lot of fun when you assist students during a build-and-test activity. An extra set of hands is always useful during experimental trials. Here are some tips for facilitating a build-and-test activity:

- Try not to be overly concerned about the correctness or precision of students' efforts. Instead, encourage their enthusiasm and help them generate more ideas.

- Be careful not to build for the students, or tell them what to do, even if they ask you to. When they ask, "How do I do this?," ask them, "Where would you start?" or "What materials might you use?" Suggest materials or techniques, or make your own prototype to show, but do not build for the students.

- When students make mistakes, help them make sense of what went wrong.

- Use thought-provoking questions to focus their attention on potential problems or possible solutions.

- Be interested in what they are doing and provide a sounding board for their ideas. Ask thoughtful questions and listen closely to their answers. Give students an opportunity to develop and express their thoughts.

- Listen for the hypotheses they create to explain the performance of their toy vehicle. Support them in conducting experiments to test these hypotheses.

Logistics for Successful Volunteering

To ensure that your own experience will be enjoyable and productive, give consideration to the following managerial and organizational details:

- Get directions to the school, information on where to park your car, and instructions on the school's procedure for signing in.

- Review the description of the challenge the class will be doing and become familiar with the content of the unit as much as possible.

- Leave sufficient time to meet or talk with the teacher to go over the curriculum and proposed scheduling.

- Find out how the teacher prefers to communicate with you. If you rely on phone calls, be sure to exchange school and/or home numbers and best times to call. If you plan to communicate by e-mail, let each other know how often you check your mail.

- Schedule your visits in advance and check with the teacher a day or two ahead of each planned visit to confirm your arrangements.

How to Promote the Curriculum to Teachers

Although some teachers may learn about *A World in Motion:The Design Experience, Challenge 1* at national conferences, the Society of Automotive Engineers relies on industry professionals to promote the curriculum in their local communities. Here are some ways you can raise awareness of this program:

- Talk to your child's teacher about possibly doing one of the challenges and offer to assist the teacher.

- Ask the teacher for names of other teachers who may be interested in doing a challenge.

- Call schools or central administration offices and get contact information for math and science coordinators.

- Go to school events such as Family Night to meet teachers.

- Put flyers describing the program in school offices.

- Network with educators, parents, engineering professionals, and others in your community.

Good luck and happy volunteering!