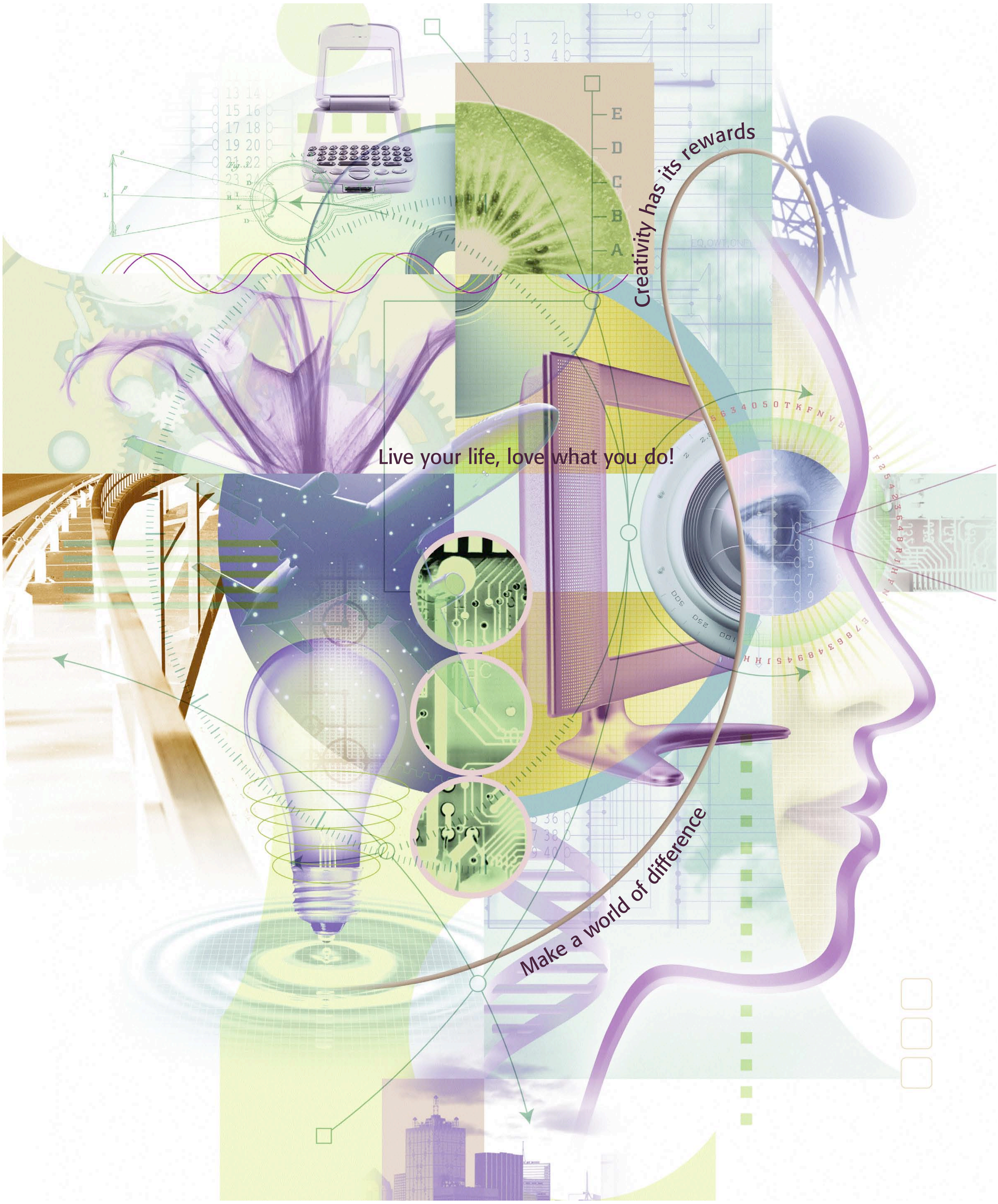

Introduce a Girl to Engineering

Participate in *Introduce a Girl to Engineering Day* as part of Engineers Week.
Join others around the country for the eighth annual event on ***February 21, 2008.***

Major Support Provided By Agilent Technologies, Inc. and S. D. Bechtel, Jr. Foundation.
Additional Support Provided By Motorola Foundation.

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ENGINEERS WEEK® 2008
February 17-23

Ups and Downs in Design

OBJECT

The science behind how things move (physics) is of great importance to engineers. The goal here is for students to understand the basics of engineering design associated with kinetic and potential energy as they design, build, and test foam tubing roller coasters.

GRADE LEVEL

Appropriate for middle through high school, depending on depth of discussion and extensions. Referenced worksheets for students are on *http://www.eweek.org/site/DiscoverE/activities/index.shtml*

DISCUSSION

Potential energy: Energy an object has because of its relative location.

Kinetic energy: Energy associated with motion of an object.

Gravitational force: Force exerted between the earth and an object that attracts the object toward the earth.

Roller coasters at amusement parks utilize potential energy and kinetic energy. Typically the roller coaster car is pulled up by a motor, gaining its potential energy. Once at the peak point, there are no motors connected to the car in any way. The car begins its winding and looping decent along a track that has been designed to safely transfer the potential energy into kinetic energy while making it a thrilling ride. The diameter of the loops that the car will traverse without falling out is dependent on the kinetic energy obtained by the car.

If the car is going through a loop-de-loop, and does not have enough kinetic energy, the car will not stay on the track as it reaches the peak of the loop. See Worksheet 1 for measurement formulas and reference diagram.

Ideally, all the potential energy is converted to kinetic energy. This never holds true, as some of the energy is lost to friction. Because of the loss of energy, the peak of the loops must be lower than the initial starting point of the car.

MATERIALS

- 5-7 six-foot lengths of foam pipe insulation tubing cut in half lengthwise per group.
- masking tape
- round toothpicks (approx. 20 per group)
- 16mm marbles (5 per group)
- container to catch marbles
- flexible tape measure
- scissors and ruler
- two different colored stickers: one marked "P", the other "K"

ACTIVITY

The challenge: to design a roller coaster ride to be as "loopy" as possible and safe while keeping building costs to a minimum.

Part 1: ***Design and Preliminary Testing***

Discuss worksheet 1 (Reference Diagram). Hand out Worksheet 2 (Building Guidelines). Break the class into groups of 3.

1. Give each group one marble, a container to catch the marble, one foam piece, one toothpick, and a one-foot piece of masking tape.
2. Have each group design and test a preliminary prototype.
3. As they test, each group should be planning their final design and the amount of materials that will be needed (Worksheet 3). After 15 minutes, have the students return the materials from the preliminary prototypes and obtain the materials listed in Worksheet 3 from the "store." Once materials have been bought they may not be returned or exchanged.

Part 2: ***Final Design and Testing***

1. Allow 10 minutes to finalize designs. Groups use P and K stickers to mark the places on their roller coasters that have the greatest kinetic and potential energy.
2. Test each roller coaster. Each must be able to stand alone, and the marble must travel completely from start to finish. Allow 2 tries.
3. Have groups measure the diameter of each loop in the roller coaster and total the cost of purchased materials in Worksheet 3.
4. Cost analysis: Have students compute the loop diameter to cost ratio.
5. Discuss results. Was there a stronger design/construction that seemed to work? How did potential and kinetic energy play a role? Most importantly: Is the ride safe?
   - Why do most roller coasters have corkscrew turns instead of loop-de-loops? It takes a lot of kinetic energy to make it all the way around a loop-de-loop. Corkscrew turns (twisty downhill turns) simply use the potential energy to gain speed through the turn.

CONNECT TO ENGINEERING

Engineers use their math and science know-how in all areas of an amusement park. They need to understand how to make rides fast and fun, without compromising structural integrity which is needed for ride safety. Engineers use other skills to make line wait-times shorter, park layout inviting and environmentally friendly, services like food delivery and trash control efficient, and park security up-to-date.

Activity Extensions: see ***www.eweek.org*** (K-12 section) and ***www.myphysicslab.com/RollerSimple.html***

This activity adapted from the TeachEngineering Digital Library based on the "Making The Connection" activities from Women in Engineering Program and Advocates Network (WEPAN) www.wepan.org. JETS has partnered with the Engineering Pathway (www.engineeringpathway.org) and the TeachEngineering Digital Library (*www.teachengineering.org*). See *www.jets.org*.

How to Participate in Introduce a Girl to Engineering Day

Many girls — representing half the future work force — are not receiving the guidance and encouragement they need to enter the engineering arena. Engineers Week's Introduce a Girl to Engineering Day is designed to mobilize as many as 10,000 engineering and technical professional women, who, along with their male colleagues, will reach at least one million girls.

Career messages that especially resonate with academically prepared girls are outlined in the adjacent panel (Why Engineering?) Here are a few ways to participate and deliver the messages. Find more ideas in the archives of past events: ***http://www.eweek.org/site/News/Eweek/nationalpledgeroster_archive.shtml***

In addition to Introduce a Girl to Engineering Day, participate in the March Global Marathon For, By and About Women in Engineering, connecting women worldwide for a full 24 hours. Find information at ***www.eweek.org.***

EASY WAYS YOU CAN PARTICIPATE IN INTRODUCE A GIRL TO ENGINEERING DAY

Contact a local school and visit a classroom. We have advice on how you can and what to do when you're there.

Contact a local girls' school. Want to find out if there's one in your area? Check with the National Coalition of Girls' Schools, ***www.ncgs.org.***

Offer to host a special program at your local science center.

Let a high school student shadow you on the job.

Hold a Saturday program for employees' daughters and granddaughters and send them on a scavenger hunt to find engineered objects, or on a GPS search for hidden treasure.

Work with a local Girl Scout troop. Some troops may be interested in working on technology-related badges.

Host a role model luncheon. This provides girls with an opportunity to interact with a variety of women role models. Be sure to have at least one role model at each table with the girls. You might also want to include a panel discussion or hands-on activity.

We appreciate and welcome your participation.

Don't forget to sign our National Pledge Roster! Everything you need is at ***www.eweek.org.***

RESOURCES ESPECIALLY FOR GIRLS

www.engineergirl.org
(National Academy of Engineering)
www.gettech.org
www.girlscouts.org
www.girlsinc.org
www.girlstart.org
www.swe.org
(Society of Women Engineers)
www.wieo.org

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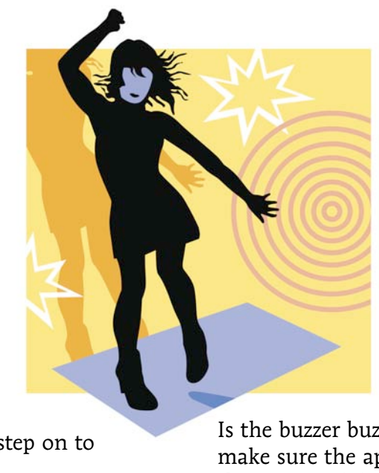
Visit our homepage at ***www.eweek.org***

Dance Pad Mania



INTRODUCTION

OBJECT

This activity will demonstrate the engineering design process. Teams must work together to build a dependable, functional electric circuit.

GRADE LEVEL

Middle school.

THE CHALLENGE

Build a dance pad that students step on to sound a buzzer or flash a light.

MATERIALS

- 1.5-volt AA battery
- AA battery holder (optional)
- Aluminum foil
- Bulb holders for light bulbs (enough for half the group)
- Buzzers (enough for half the group)
- 2 11 x 17-inch sheets of corrugated cardboard (per team)
- Duct tape
- Electrical wire (22-gauge works well)
- Light bulbs that can run on a 1.5-volt AA battery
- Plastic wrap
- Scissors
- Wire strippers

Estimated time to complete: 60 minutes

DISCUSSION

Encourage students to work cooperatively, rather than competitively: When you work as a team, you can often solve design challenges more quickly. For example, you can share knowledge, get new ideas, and brainstorm solutions to problems. You can also learn a lot by looking at how other teams made their pads and seeing how they solved problems.

BRAINSTORM AND DESIGN

Divide your group into teams of two. Half the teams will make floor pads that flash a light, and the other half will make floor pads that sound a buzzer. The dance pad is basically a simple electric circuit, with a power source (the battery), materials for conducting electricity (the wires and foil), and something that uses the electricity (the buzzer or light). Brainstorm answers to the following questions and have students record ideas.

- Will my pad turn on a buzzer or a light?
- How will I build a switch into my pad to turn the buzzer or light on and off?
- How big will my pad be?
- How can I make it sturdy enough to withstand constant stomping?
- Where will I put the battery? Inside the pad? Outside the pad?

BUILD, TEST, AND REDESIGN

Hints for the students if they have trouble getting started:

Connect the parts: To make the buzzer buzz or the light flash, they need to get electricity from the battery to the buzzer. To do this, connect the buzzer (or light), battery, and wires. This makes an electrical circuit.

Is the buzzer buzzing or light lighting? If not, make sure the appliance's red wire is attached to the positive (+) side of the battery and the black wire to the negative (-) side.

Add a switch to start and stop the flow of electricity. When the switch is closed (called a closed circuit), electricity flows to the buzzer/light and it buzzes or flashes. An open circuit turns off the appliance. *Hint:* use the dance pad to open and close the circuit—it becomes the switch!

As they build, make sure the circuit works and that it will be able to stand up to some rugged treatment. Build the pad, then test it. Step on it several times in a row to turn the buzzer or light on and off. How well did it work? The teams might need to debug. For example, loose wires will make the pad stop working. Have the teams re-design to fix the problem so the pad works every time.

TAKE IT TO THE NEXT LEVEL

- Make a pad that has both a light and a buzzer.
- Make a pad that uses two batteries, two lights, or two buzzers.

CONNECT TO ENGINEERING

Bust a move! Break it on down and get a good workout at Overtime Fitness™, a revolutionary fitness arcade for teens. Forget what you know about gyms, this is the gym of the future. Get your heart pumping with In the Groove 2®, a dance game that works like Cyber Groove™, Dance Dance Revolution®, Feet of Fury™, and "Pump it Up"®. Just try keeping up with those moving arrows! Or, you can even hook yourself up to a video game box and become a human joystick to move an on-screen player. The sensors, computers, sound systems, and software that make these games work were all brought to you by engineers. What will these geniuses think of next?

Watch Design Squad at
www.pbskidsgo.org/designsquad

Major funding for Design Squad is provided by the National Science Foundation and the Intel Foundation.

Additional funding is provided by Tyco Electronics, National Council of Examiners for Engineering and Surveying, The Harold and Esther Edgerton Family Foundation, the Noyce Foundation, Intel Corporation, the American Society of Civil Engineers, and the IEEE. This Design Squad material is based upon work supported by the National Science Foundation under Grant No. ESI-0515526. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Why Engineering? Ten Great Reasons

1. **Love your work, AND live your life too!**
   Engineering is an exciting profession, but one of its greatest advantages is that it will leave you time for all the other things in your life that you love!
2. **Be creative.**
   Engineering is a great outlet for the imagination—the perfect field for independent thinkers.
3. **Work with great people.**
   Engineering takes teamwork, and you'll work with all kinds of people inside and outside the field. Whether they're designers or architects, doctors or entrepreneurs, you'll be surrounded by smart, inspiring people.
4. **Solve problems, design things that matter.**
   Come up with solutions no one else has thought of. Make your mark on the world.
5. **Never be bored.**
   Creative problem solving will take you into uncharted territory, and the ideas of your colleagues will expose you to different ways of thinking. Be prepared to be fascinated and to have your talents stretched in ways you never expected.
6. **Make a big salary.**
   Engineers not only earn lots of respect, but they're highly paid. Even the starting salary for an entry-level job is impressive!
7. **Enjoy job flexibility.**
   An engineering degree offers you lots of freedom in finding your dream job. It can be a launching pad for jobs in business, design, medicine, law, and government. To employers or graduate schools, an engineering degree reflects a well-educated individual who has been taught ways of analyzing and solving problems that can lead to success in all kinds of fields.
8. **Travel.**
   Field work is a big part of engineering. You may end up designing a skyscraper in London or developing safe drinking-water systems in Asia. Or you may stay closer to home, working with a nearby high-tech company or a hospital.
9. **Make a difference.**
   Everywhere you look you'll see examples of engineering having a positive effect on everyday life. Cars are safer, sound systems deliver better acoustics, medical tests are more accurate, and computers and cell phones are a lot more fun! You'll be giving back to your community.
10. **Change the world.**
    Imagine what life would be like without pollution controls to preserve the environment, life-saving medical equipment, or low-cost building materials for fighting global poverty. All this takes engineering. In very real and concrete ways, engineers save lives, prevent disease, reduce poverty, and protect our planet.

For additional resources for parents, counselors and engineers, check out *engineeryourlife.org* — a guide to engineering for high school girls

- Trainings
- Brochures and posters
- Booths at college fairs

Adapted from the ENGINEER YOUR LIFE report prepared by Extraordinary Women Engineers Project coalition member WGBH-TV, Boston's PBS station.

This poster is made possible by Engineers Week partners, with additional support from Agilent Technologies, Inc., the S. D. Bechtel, Jr. Foundation, and the Motorola Foundation.

Engineers Week 2008 is chaired by IBM Corporation and Chinese Institute of Engineers-USA.