Dear Educators,

Intel welcomes you to the new reality-based PBS series, *Design Squad™*! Our sponsorship is the newest component of our Intel® Education Initiative, which is committed to twenty-first century teaching and learning through the effective use of technology and excellence in mathematics, science, and engineering.

*Design Squad*’s substantive focus on math, science, and the design process sparks young people’s curiosity about the world and hones their problem-solving skills. By showcasing engaging, real-life applications of engineering, we believe that *Design Squad* will increase their interest in the subject. Engineering will be presented as the creative career we know it to be, enabling young viewers and participants to turn science into reality.

We encourage you to use the *Design Squad* Educator’s Guide—in concert with the television series and the Web-based outreach components—to help young people investigate and solve challenging problems. The goal is to pique the next generation’s interest in engineering as a career, and in science and mathematics as the fascinating means to intriguing ends. The ripple effect you create will change lives.

Sincerely,

Brenda Musilli
President, Intel Foundation
This guide has everything you need to bring engineering to life for kids aged 9–12 in your afterschool program or classroom. The guide’s ten hands-on challenges emphasize teamwork and creative problem solving. From the Leader Notes to the Discussion Questions to the Challenge Sheets, you have what you need to unleash your kids’ ingenuity and to get them thinking like engineers.

2 Introducing the Design Process
4 Setting up a Design Squad Club
6 Sources for Materials

UNIT 1: IT’S ELECTRIC
Kids design and wire up two devices and put them through some rigorous (and fun) testing.
7 Hidden Alarm. Build a circuit to power an alarm so small that you can hide it.
10 Dance Pad Mania. Build a dance pad that sounds buzzers and flashes lights.
13 Dance Off. Play a game that puts the dance pads to the test.

UNIT 2: CARS, CARS, CARS
Kids build three cars, using the design process to turn their ideas into reality.
16 Rubber Band Car. Make a two-wheeled car powered by a rubber band.
19 Motorized Car. Add a motor to your rubber band car.
22 Customized Car. Choose one of several ways to modify your car.

UNIT 3: BLOWIN’ IN THE WIND
Kids design and build two tall towers and learn what makes structures strong and stable.
25 High Rise. Build a tall tower that can support a tennis ball.
28 Kinetic Sculpture. Build a tower with parts that move in the wind.

UNIT 4: KICK START
Kids design and build two machines that can reliably carry out some challenging tasks.
31 Kicking Machine. Build a machine that kicks balls across the floor.
34 Extreme Kicking Machine. Modify your kicking machine in one of two ways.

37 Science and Technology Content Standards

FIND SOMETHING TO FIT YOUR SCHEDULE

• Do one meeting: The first challenge of each unit is stand-alone. Choose any one of these.
• Do most of a unit: Both It’s Electric and Cars, Cars, Cars have three challenges, but you can do just Challenges 1 and 2.
• Do a full unit: Each unit is self-contained and doesn’t depend on the work done in other units. However, once you start a unit, do its challenges in sequence, because later challenges build on earlier ones.

You can find a combination of activities that's just right for your group. Each challenge takes an hour.
When engineers set out to solve a problem, their first solution is rarely their best. Instead, they tinker, try different ideas, fail, learn from mistakes, and try again. The series of steps engineers use to arrive at a solution is called the design process.

You can approach almost any problem using the steps of the design process—it’s a great way to come up with lots of ideas, improve a design, and learn from mistakes. In fact, the design process is something people use every day—planning an outing, writing a letter, making breakfast, or doing any task where they create something that did not exist before.

REINFORCING THE DESIGN PROCESS WITH YOUR KIDS

- As kids progress through a challenge, point out which step of the design process they are doing.
- Engineers communicate visually as well as verbally. Have kids keep design notebooks to record and sketch their ideas and results.
- Try every challenge yourself before doing it with kids. This will help you anticipate where kids might need assistance, and you’ll be prepared to respond to questions that might come up.
- When something fails, encourage kids to try again. They’ll come up with lots of interesting solutions and learn from their mistakes.
- Avoid giving too much direction; it discourages kids from thinking for themselves. Answer questions by asking a question back. This helps kids discover their own answers. (See examples below.)

QUESTIONS FOR GUIDING KIDS

<table>
<thead>
<tr>
<th>To help a child…</th>
<th>Ask…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stay focused on the activity</td>
<td>“What do you need to do now?”</td>
</tr>
<tr>
<td>Answer his/her own question</td>
<td>“That’s an interesting question, how can we find out?”</td>
</tr>
<tr>
<td>Problem-solve or try another approach</td>
<td>“Why do you think this happened?”</td>
</tr>
<tr>
<td>Make connections to the real world</td>
<td>“Is there another way to look at this?”</td>
</tr>
<tr>
<td>Improve his/her design</td>
<td>“What are other examples where this happens?”</td>
</tr>
</tbody>
</table>

(Adapted from Harlen, Wynne, (ed.), Taking the Plunge: How to Teach Primary Science More Effectively. Portsmouth, NH: Heinemann, 1985. Also from “Putting Girls at the Center in Math, Science and Technology.” © 2003 Girl Scouts of the USA. Used with permission.)
**KIDS CHALLENGE SHEETS REINFORCE THE DESIGN PROCESS**

The different parts of each Challenge Sheet are clearly labeled with the different steps of the design process. After completing a few challenges, kids will begin to see that the design process is a way to think creatively about a problem and work it through, from beginning to end.

**LEADER NOTES REINFORCE THE DESIGN PROCESS**

The steps of the design process offer a framework for the Leader Notes, which always use the three sections described below to help you reinforce the design process for kids throughout a challenge:

1. **Introduce the challenge, brainstorm, and design.**
   Before building, engineers define the problem they want to solve and come up with a variety of solutions—the more, the better. At the start of every challenge, provide a few minutes for kids to individually brainstorm solutions, jot notes, and sketch possible designs in their notebooks. Then have them share their ideas and brainstorm as a group. List their ideas on chart paper or a board and refer to them later during the redesign phase.

2. **Build, test, and redesign.**
   Once kids finish the brainstorm, have them settle on a design idea to start with. It’s unlikely that kids’ first solutions will be their best, and as they build, they’ll need to refine their ideas and solve problems that come up. At the heart of the design process is the attitude that “if at first you don’t succeed, try, try again.” The design process offers kids a structured way to take an idea from its initial to its “finished product” stage, learning from mistakes they make along the way.

3. **Discuss what happened.**
   Engineers present their work to colleagues to show how they solved a problem. This way, they learn new ideas and approaches from each other. At the end of each meeting, have kids show each other what they built and talk about how they used the design process to solve the challenge. Also, point out interesting solutions and examples of creative thinking and effective teamwork. If applicable, mention how much progress the group has made over the weeks. Get excited and congratulate them on a job well done.

**WHAT’S ENGINEERING?**

“Engineers get to imagine the future and design for it.”
—Marisa Wolsky, Design Squad Executive Producer

“Engineering prepares you with the basic skills to tackle any problem.”
—Alba Colon, NASCAR engineer

“Engineers create new products and new systems that improve people’s lives and meet the needs of society.”
—Heidi Nepf, Professor of Engineering

[Design is] “...not just what it looks like and feels like. Design is how it works.”
—Steve Jobs, Innovator
New York Times, 11/30/03
SETTING UP A DESIGN SQUAD CLUB

In a Design Squad club, you can use the guide’s ten hands-on challenges to show kids how interesting and exciting engineering is. Kids practice important skills, such as problem solving, teamwork, critical thinking, and creativity—skills and attitudes you already promote in your program. You can run a Design Squad club just about anywhere. All you need are a large room, some tables, and some low-cost materials. The resources in this guide and on the Web site make it easy to facilitate the challenges and engage kids in engineering.

STARTING A DESIGN SQUAD CLUB
STEP-BY-STEP

1 Recruit club members.
   • Create a “Coming Soon” bulletin board and post a flier about the club.
   • Advertise the club in your organization’s newsletter. Use language from this guide to describe the show and the challenges that kids will do. Tell families how to sign up their kids.
   • Determine the number of kids you feel comfortable managing (we suggest 8 to 12 per leader). If more sign up, get more leaders, divide the club into two sessions, or keep a waiting list for the next time you offer a club.

2 Schedule the dates and arrange a meeting place.
   • Decide how many weeks your club will meet and the duration of each meeting. Then select and reserve a space that has ample room and tables for materials. A place to store kids’ work is also helpful.

3 Give your room a Design Squad club look and feel.
   • Download the Design Process sign from the Web site and hang it in your clubroom.
   • Make a bulletin board and post photos and examples of the challenges so others can see what goes on at Design Squad club meetings.

4 Partner with an engineer.
   • Invite engineers to visit your club to talk about everyday examples of engineering and discuss the challenges’ engineering principles. They can also act as role models and introduce kids to career options. To find volunteers, contact local universities and colleges with engineering programs. Also try manufacturing plants and public works and water departments. In addition, the Design Squad and www.eweek.org Web sites list engineering societies that can recommend potential partners.
   • Show kids the D Squad Pro Files of engineers. In these clips, engineers talk about how they became interested in engineering and the rewards of being an engineer. Download the clips from the Design Squad Web site at pbskidsgo.org/designsquad/engineers.

OLDER KIDS LOVE DESIGN SQUAD CHALLENGES, TOO

Design Squad activities appeal to anyone who loves using his or her ingenuity to tackle open-ended challenges. Consider starting a club for older kids who may be aging out of your afterschool program.
Web
Download the following resources for your engineering club, program, or event from the Design Squad Web site at pbskidsgo.org/designsquad/engineers:

- **Design Squad Event Guide.** Spark kids’ interest and confidence in engineering by hosting a lively, fun-filled event, such as a family night or science and engineering day. To help you plan and organize your event from beginning to end, the Event Guide provides you with an event checklist, reproducible challenge sheets for five challenges, and an evaluation form.

- **Video clips.** Show kids a brief clip about the show, D Squad Pro Files of engineers, and animations that demonstrate the show’s science and engineering principles.

- **Challenges in Spanish.** The five Event Guide challenges are available in Spanish and English.

- **Iron-on Design Squad logo transfers.** Make Design Squad T-shirts for yourself and your kids.

- **Design Process sign.** Hang this sign in your room to help set the tone and to refer to during a challenge.

Professional Development

- **Attend a Design Squad training.** We’re hosting a series of nationwide trainings for engineers and informal educators on ways to connect kids to engineering. A training will help you find engineering partners, give you tips on doing challenges with kids, and provide ideas for introducing your colleagues to engineering. To learn more, contact Design Squad’s Outreach Coordinator at designsquad_feedback@wgbh.org.

- **Sign up for the Design Squad e-newsletter.** Get updates on the show, Web site, trainings, and resources. To sign up, visit the Design Squad Web site at pbskidsgo.org/designsquad/newsletter.