Dear Educators,

Intel welcomes you to Season 2 of PBS’s reality competition series, Design Squad™! Our sponsorship is a component of our commitment and active involvement in today’s education to inspire tomorrow’s innovators. In the past decade, Intel has invested over one billion dollars and Intel employees have donated over two million hours toward improving education in 50 countries. Design Squad, with its substantive focus on math, science, and the design process, is closely aligned with our mission of engaging young people’s curiosity about the world and developing their skills to become the next generation of innovators.

In Season 1, Design Squad set out to increase kids’ interest in engineering by showcasing engaging, real-life applications of engineering. And it worked! After researching the impact of the TV series, Web site, and educator guides, an independent evaluator found a significant jump in kids’ learning and a uniformly positive, enthusiastic response from viewers, educators, and kids. For example:

Afterschool program leaders:
- reported that the guides were easy to use and contained everything they needed.
- said they will use the guides again and recommend them to others.
- felt the guides’ background materials and leader notes enabled them to talk confidently about the science and engineering in the challenges.
- developed a strong understanding of the design process and how to help kids put it into action.

Kids in afterschool programs:
- loved the engineering challenges.
- learned the science concepts in the challenges.
- increased their understanding of engineering and the design process.

We encourage you to use Design Squad to bring the possibilities of engineering to life for young people and inspire them to investigate and solve challenging problems that could change the world!

Sincerely,

Brenda Musilli
President, Intel Foundation
This guide offers five hands-on challenges that bring engineering to life for kids aged 9–12. They offer anyone running afterschool programs, workshops, or events engaging, effective ways to get kids thinking like engineers. The challenges are versatile—they don’t require much facilitation, use modest amounts of readily available materials, give kids many ways to succeed, and are manageable with large numbers of kids. Use them for ongoing programs AND events.

Introducing the Design Process  
Talking to Kids about Engineering  
Fit Design Squad into any Program  
Web Resources  
Hosting a Design Squad Event  
Sources for Materials  
Science and Technology Content Standards  

**Challenge 1: Watercraft**
Find out if you can build an unsinkable boat out of straws and plastic wrap.

**Challenge 2: Paper Table**
See how strong a table you can build out of paper.

**Challenge 3: Zip Line**
Test how quickly you can get a Ping Pong ball to the bottom of a zip line string.

**Challenge 4: Paddle Power**
Check out how fast a boat can paddle itself across a container of water.

**Challenge 5: Helping Hand**
See how many objects you can grab with a homemade “bionic” arm.

The reproducible challenge sheets are also available online in both English and Spanish at pbs.org/designsququad/parentseducators.
THE DESIGN PROCESS

The design process is a great way to tackle almost any task. In fact, you use it each time you create something that didn’t exist before (e.g., planning an outing, cooking a meal, or choosing an outfit).

When engineers solve a problem, their first solution is rarely their best. Instead, they try different ideas, learn from mistakes, and try again. The series of steps engineers use to arrive at a solution is called the design process.

INTEGRATE THE DESIGN PROCESS INTO ACTIVITIES

As kids work through a challenge, use the questions below to tie their work to specific steps of the design process.

**Brainstorming**
- At this stage, all ideas are welcome, and criticism is not allowed. How creative can you be?
- What specific goal are you trying to achieve, and how will you know if you’ve been successful?
- What are some ways you can start tackling today’s challenge?

**Designing**
- Time to get realistic. Talk through the brainstormed ideas. What’s really possible given your time, tools, and materials?
- It’s not cheating to look at other kids’ projects. What can you learn by looking at them?

**Building, testing, evaluating, and revising**
- Does your design meet the criteria for success?
- What is the hardest problem to solve as you build your project?
- Why do you have to do something a few times before it works the way you want?

**Sharing solutions**
- What do you think is the best feature of your design? Why?
- What are some things everyone’s designs have in common?
- What would you do differently if you had more time?
- What were the different steps you had to do to get your project to work the way you wanted?
EACH CHALLENGE REINFORCES THE DESIGN PROCESS

Each section of the leader notes and kids’ challenge sheets is built around the steps of the design process. Point out to kids that the titles on a challenge sheet are the steps of the design process.

- **Introduce the challenge**—Offers simple demonstrations and presents questions (and answers) about the activity’s key concepts. This quick review introduces the activity’s important ideas and terms.

- **Brainstorm and design**—Raises discussion questions to help kids think about different ways to tackle a challenge. Since challenges offer kids many ways to succeed, this section helps jump-start their thinking about various approaches and possibilities. At this stage, the more ideas, the better. But before moving to the “build” step, be sure that each kid narrows the list of ideas and settles on something specific to design.

- **Build, test, evaluate, and redesign**—Lists common issues that surfaced when the challenges were field tested as well as strategies to use with kids who are facing these issues.

- **Discuss what happened**—Provides questions (and answers) to review the activity’s key concepts and to help kids reflect on how they used the design process in the challenge.

- **For events**—Offers tips on setting up and running the challenge in an event setting.

- **Kids’ challenge sheets**—Each section of a challenge sheet correlates with a different design process step. After completing a few challenges, kids see that the design process lets them think creatively about a problem and produce a successful result.

HOW TO REINFORCE THE DESIGN PROCESS WITH KIDS

Open-ended challenges have no single right answer, so kids are inspired to come up with their own solutions. Use these tips to help kids explore!

- As kids progress through a challenge, point out the steps of the design process that they’re doing.

- Encourage kids to come up with several ways of solving a problem before they move ahead with one idea.

- Avoid giving too much direction; it discourages kids from thinking for themselves.

- When something fails, encourage kids to try again. Mistakes are opportunities for learning. In fact, the *Design Squad* motto is, “Fail fast—succeed sooner.”

- Guide kids by asking questions. To help kids discover answers for themselves, ask: What have you tried? How did it work? Why do you think it didn’t work? What else could you do?

- Engineers communicate visually as well as verbally. Have kids keep design notebooks to sketch their ideas and results.

- Engineers present their work to colleagues to show how they solved a problem. You can do the same by reviewing each challenge with your kids.
Few kids can say what engineering is or what an engineer does. Yet once they find out, many are hooked! You can be the one to help a young person discover his or her dream job. As you work with kids, use the information below to talk with them about engineering.

**WHAT’S AN ENGINEER?**

Engineers dream up creative, practical solutions and work with other smart, inspiring people to invent, design, and build things that matter. They are changing the world all the time.

**WHAT DO ENGINEERS DO AT WORK?**

- **Think creatively.** Engineering is an ideal outlet for imagination and creative problem solving—the perfect field for independent thinkers.

- **Work with great people.** Engineering takes teamwork. As an engineer, you’ll be surrounded by smart, creative, inspiring people.

- **Solve problems and design things that matter.** Engineers improve peoples’ lives by tackling problems, improving current designs, and coming up with solutions no one else has thought of.

- **Change the world and make a difference.** Among many other pursuits, engineers develop systems that save lives, prevent disease, reduce poverty, and protect our planet.

**HOW DO ENGINEERS MAKE THE WORLD A BETTER PLACE?**

Here are some things engineers do to help improve people’s lives.

- Create more fuel-efficient cars
- Design a lighter bike frame
- Invent a more powerful superglue
- Create satellites that detect drought around the world
- Develop state-of-the-art cell phones
- Invent artificial retinas for the blind
- Develop a feather-light laptop
- Design clothing that repels mosquitoes

**FIND OUT MORE**

For more great reasons to become an engineer, fun projects, and profiles of engineers doing innovative work, visit the following Web sites:

- Engineer Your Life at engineeryourlife.org
- Discover Engineering at discoverengineering.org/home.asp
Design Squad offers educators a total of 17 hands-on challenges in three great resources—this guide and the Educator’s and Event guides. Find all three guides online at pbs.org/designsquad.

FOR AN EVENT OR OTHER ONE-TIME OCCASION

Design Squad challenges use simple, readily available materials and are open-ended with multiple solutions that engage a wide variety of ages and ability levels. The challenges are perfect for events and for science and engineering days. Take Design Squad to a museum, library, mall, or university near you and spark kids’ interest and confidence in engineering with a lively, fun-filled event. Get signs, handouts, and a detailed checklist for planning and running an event in the Event Guide at pbs.org/designsquad/parentseducators.

FOR CLASSROOM, AFTERSCHOOL, CLUBS, AND OTHER ONGOING PROGRAMS

The challenges offer kids fun ways to apply the design process and core science concepts. They are excellent ways for kids to exercise their creativity and practice important skills, such as problem solving, teamwork, and critical thinking. Yet, each one is distinct, so kids do something different in every challenge. For step-by-step assistance in setting up a Design Squad club, check out the Educator’s Guide at pbs.org/designsquad/parentseducators.

SPREAD THE WORD

If you like Design Squad challenges, help get more people involved.

• Encourage others to do Design Squad challenges with kids.

• Publish a story about your successful event or program.

• Link your Web site to the Design Squad Web site at pbs.org/designsquad.
WEB RESOURCES

WATCH DESIGN SQUAD ONLINE
- **Episodes:** Watch all the episodes for free. Read the online descriptions to find a show that relates to what you’re doing or a topic that your kids like.
- **D Squad profiles:** View short videos of engineers who showcase diverse, creative career paths in engineering.
- **Program-viewing tips:** Use these great before-, during-, and after-watching ideas to enhance kids’ experience of watching a *Design Squad* episode.

GET MORE HANDS-ON, OPEN-ENDED ENGINEERING CHALLENGES
- **The Educator’s Guide:** Has ten challenges with leader notes, discussion questions, and reproducible challenge sheets in English and Spanish.
- **The Event Guide:** Contains five challenges with reproducible activity sheets in English and Spanish, a list of sources for materials, a detailed event checklist, and an evaluation form to help make your event a great success.

PROMOTE THE DESIGN SQUAD VISION
- **The Design Process:** More tips on how to reinforce the design process with kids.*
- **Setting Up a Club:** Guide for launching a multi-session *Design Squad* club.*
- **Engineering in Action:** Ideas for ways to share with kids your enthusiasm for engineering.**
- **Working with Kids:** Pointers on engaging kids in engineering activities, using questions to guide their work, and solving problems that come up when doing open-ended challenges.**
- **E-newsletter:** Sign up for news about the show, Web site, resources, and events and trainings.

* See Educator’s Guide Introduction  ** See Event Guide’s Designing Your Event

HOST DESIGN SQUAD EVENTS
- **How-to guide:** A detailed guide and step-by-step checklist to make your event a success. See pages 6–14 of the Event Guide.
- **Signage:** Get all the signs you need for use at an event, workshop, or *Design Squad* club.
- **Products:** Buy *Design Squad* T-shirts, pencils, and balloons. For purchase information, go to eweek.org.
- **T-Shirt transfers:** Download these iron-on transfers. Create your own *Design Squad* apparel.
- **Volunteer certificate:** Acknowledge people who have helped at an event, workshop, or club.

Find all these Web resources online at pbs.org/designsquad.
HOSTING A
DESIGN SQUAD EVENT

GENERAL EVENT TIPS

Do the challenge(s) yourself to anticipate the quantities of materials required and where kids might need help.

Review the leader notes and challenge sheet, focusing especially on how to respond to questions that might come up.

Make photocopies of the kids’ challenge sheet(s) and set them out, one per kid.

Use signs to mark activities. Download and print activity signs from the Design Squad Web site. Mount each on a firm backing and set on tabletops to advertise the activities you’re doing.

Establish testing zones separate from building areas to ease overcrowding in any one area. Download, print, and mount the Testing Zone sign from the Design Squad Web site and set it in the area devoted to testing.

CALCULATING HOW MANY MATERIALS TO BUY

Estimate how many kids will be at your event. Then add 20%. This figure will help to accommodate a larger-than-expected crowd (and kids who just LOVE tape!).

Use the “per person” guidelines in each activity’s materials list. Multiply the per person recommendation by the number you arrived at above.

Don’t consider “common” materials to be “shareable.” If you’re doing several activities that use similar materials, stock each area fully.

Gather materials in advance, and get extra! It’s better to have too many materials. You can return unopened extras or save them for next time.

SOURCES FOR MATERIALS

Most of the required materials are easy to find at local stores. If you are buying small quantities, try: hardware stores for metal washers; office supply stores for corrugated cardboard and chipboard; grocery stores for wooden skewers; and sporting goods stores for Ping-Pong balls. Large quantities of these items are available online at:

<table>
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<tr>
<th>Material</th>
<th>Quantity</th>
<th>Price/Unit</th>
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<tr>
<td>Chipboard</td>
<td>8 ½ x 11 inch</td>
<td>$40/case (960 sheets)</td>
<td>uline.com</td>
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<tr>
<td>Flat washers</td>
<td>SAE standard steel</td>
<td>Inside diameter: ½ inch</td>
<td>boltdepot.com</td>
</tr>
<tr>
<td>Ping-Pong balls</td>
<td>Item #GS29</td>
<td>$1.95/dozen</td>
<td>ustoy.com</td>
</tr>
<tr>
<td>Corrugated cardboard</td>
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</tr>
<tr>
<td>Wooden skewers</td>
<td>Item #05700</td>
<td>$1.29/100</td>
<td>netgrocer.com</td>
</tr>
</tbody>
</table>

Sources listed are examples of vendors who offer these items. We encourage you to research the sources that best fit your needs.