

MAKING IT REAL:

DRIVING HOME THE SOUNDS GOOD UNIT

Overview: Students take their work beyond the walls of the classroom, using a combination of presentations, videos, and discussion. They present their instruments, discuss how they demonstrate the unit's science concepts, explain how the design process encourages them to think creatively, and discuss how engineering is a field centered on designing and building things that matter.

Preparation

□ Visit pbs.org/designsquad and download the following video clips from the "Teacher's Guide" page: **Rock On Judging** (2½ minutes), **Design Process: Brainstorming About Pitch** (3½ minutes), and **Darrin Barber** (1½ minutes). Be prepared to project them.

1 Raise student awareness of engineering (5 minutes)

Our world is molded by the engineering that surrounds us. Yet, many students are unaware of what engineers do. Probe students' ideas about engineering. Ask:

- What do engineers do? (*List students' ideas.*)
- Then ask: What things in this room were probably designed or made by engineers? (*There is very little in the room other than the people, plants, and dirt that does not bear the mark of an engineer.*)

2 Relate students' work to science and engineering (20 minutes)

Show **Rock On Judging**, in which the band evaluates the instruments that were designed and built by the *Design Squad* teams and selects a winner. Then ask: How is the process you followed similar to the one the kids on *Design Squad* did? (*Both the students and the Design Squad teams brainstormed lots of ideas, then built, tested, and revised their instruments, and presented their designs to others.*)

Show **Design Process: Brainstorming About Pitch**, in which the *Design Squad* teams discuss the variables affecting pitch and brainstorm designs. Have students present their instruments and headphones. Use the following questions to explore key points in the video and unit:

- How did your design transfer the strings' vibrations through and out of the instrument? (*Students should talk about how their designs and materials effectively transmitted vibrations and how they eliminated things that absorbed vibration, such as excess tape.*)
- How did you produce different pitches on your instrument?
- How did what you learned about sound in *Build a Band* help you when you designed and built your headphones?
- What were some of the problems you solved as you built, tested, and redesigned your instrument and headphones?
- If you could improve one thing about your instrument or headphone, what would it be?
- Tell students that their instruments and headphones are **prototypes**—models for testing and improving an invention. Ask: What would you look for in an ideal stringed instrument? (*Loud; easily tunable; easily playable; wide range of pitches; parts vibrate well together; affordable; cool design; etc.*)



SHOW KIDS THE RELATED TV EPISODE



Show students *Rock On*, the full-length *Design Squad* TV episode related to the *Sounds Good* unit, where the *Design Squad* teams design and build original instruments for an avant-garde rock band. Watch it online at: pbs.org/designsquad.

"The discussion, animations, and videos had my students linking the concepts to the engineering process."

Harini A.
Belle Haven Elementary School
Menlo Park, CA



Students develop a working knowledge of sound in *Build a Band*, take their understanding further in *Headphone Helper*, and explore the relevance of the science and engineering in *Making It Real*.

3 Meet an engineer (10 minutes)

- View the **Darrin Barber** video to introduce students to an engaging young engineer who uses sonar—traveling, bouncing sound waves—to navigate a submarine. Darrin also talks about how engineering is one of the “coolest” jobs he can imagine.
- After watching, review how sonar works. *(A device sends sound waves out into the water. When they hit an object, they bounce back. Listening devices on the submarine pick up these reflected waves. By analyzing the patterns of the returning waves, people can determine where the object is. Note that bats use a similar system to detect their prey.)*
- Darrin mentions that every day he uses the math and science he learned in high school. Ask: How might the math and science you learn in school be important on board a submarine? *(It would help you understand how the equipment works, what the signals mean, how to navigate around the ocean, and how to explain to others what’s going on.)*

4 Make the engineering real (10 minutes)

Use the following questions to help students see how the work they did relates to engineering and see that engineers design things that matter and improve people’s lives. Ask:

- Who might be interested in a low-cost, low-tech musical instrument? *(Kids, parents, schools, recreation centers, camps, afterschool programs, people interested in new kinds of sounds [like White Noise, the band in Rock On]. Instrument manufacturers would be interested in a prototype instrument. The message is: Music matters—people love music and there will always be a demand for instruments and sound systems.)*
- Engineering opens the door to many interesting careers, such as navigating a submarine. What are some challenges that an engineer might tackle? *(Designing instruments and amplification and recording systems; making pitch-correction systems for singers; applying new materials and technology; writing programs for computers and electronic instruments; developing personal music players; figuring out ways to integrate sound and video; designing cutting-edge telephones; developing sonar and radar systems; etc.)*
- In what ways did you think and work like an engineer as you made your instrument and headphone? *(Followed the design process; applied science concepts; made something people want; used creativity; tackled interesting challenges)*

TELL US WHAT YOU THINK

Take our quick online survey, and we’ll send you a *Design Squad* class pack (while supplies last—see back cover for details).

Extension Ideas

- Share photos of your students' designs and see what others have made. Visit DS XCHANGE, *Design Squad's* online community at pbs.org/designsquad.
- Tell students about inventions that produce high-frequency pitches. Teens can hear them, but most adults can't. Storeowners use these devices to annoy and drive away loitering teens. Teens use the high-pitched tones as cell phone ring tones that adults can't hear! Ask students to think of other applications. Take this high-pitch hearing test and listen to the related National Public Radio podcast at: npr.org/templates/story/story.php?storyId=5434687.
- Watch *Design Squad* host Nate Ball demonstrate a pen that plays music as it draws: youtube.com/watch?v=mG6tkthHH2A.

Interdisciplinary Connections

- *Music:* Work with a music teacher to identify tunes the students may be familiar with and to get larger groups playing together.
- *Music:* Compare the design features (form and function) of various stringed instruments: violin, guitar, banjo, harp, washboard bass, zither, and piano. Focus on how they achieve pitch and amplitude, the number and type of strings, the size and shape of the sound boards, the methods of producing vibrations and projecting sound, and other design features.
- *Technology:* Use computer-based recording software to record one or more instruments. Students can multitrack, add effects, add percussion, loop their compositions, make a ring tone, and even burn a CD.
- *Shop:* Students can make an instrument out of wood. It could have a neck (like a guitar), be a frame (like a harp), or be a box (like a dulcimer, zither, or autoharp). They can experiment with different string materials, sound holes, sound boxes, soundboards, and tuning systems.



In their presentations, students talk about how sound travels through an instrument and how eliminating things that absorb vibration increases the volume.



The design process encourages students to think creatively about tackling a challenge.