

Engineers Make a World of Difference



Engineers Week is made possible by the National Engineers Week Foundation and Corporate Affiliates, in addition to other supporters.

Samuel J. Palmisano, Chairman of the Board, President and Chief Executive Officer, IBM Corporation, Honorary Chair, Engineers Week 2008.

Patrick Y. Chang, Chairman, Chinese Institute of Engineers-USA, Chair, Engineers Week 2008.

MEMBERS OF THE ENGINEERS WEEK COMMITTEE

Chinese Institute of Engineers-USA – Chair, American Council of Engineering Companies, American Institute of Chemical Engineers, American Society of Civil Engineers, American Society of Heating, Refrigerating and Air-Conditioning Engineers, ASME, Engineers Week Coalition Diversity Council, IEEE-USA, Institute of Industrial Engineers, National Council of Examiners for Engineering & Surveying, National Society of Professional Engineers, Project Management Institute, Society of Petroleum Engineers

WITH SUPPORT FROM

U. S. Army Corps of Engineers, U. S. Navy Nuclear Propulsion Program

2008 CORPORATE AFFILIATES

IBM Corporation, Chair, Bechtel Group Foundation / S. D. Bechtel, Jr. Foundation, The Boeing Company, BP p.l.c., CH2M HILL, ConocoPhillips, DuPont, ExxonMobil, Fluor Corporation, Intel Foundation, Lockheed Martin, Motorola Foundation, Northrop Grumman Foundation, Raytheon Company, Rockwell Collins, Symantec Corporation, 3M Foundation

ADDITIONAL SUPPORT FOR THE NATIONAL ENGINEERS WEEK FUTURE CITY COMPETITION PROVIDED BY Bentley Systems Incorporated.

National Engineers Week Foundation
1420 King Street
Alexandria, Virginia 22314

National Engineers Week and Engineers Week are registered trademarks of the National Society of Professional Engineers. Visit us at www.eweek.org.

♻️ Printed on recycled paper.



**ENGINEERS
WEEK® 2008**
February 17-23

Kicking Machine



OBJECT

This activity will demonstrate the engineering design process. Students will consider both potential and kinetic energy while they plan, design, build, test, and redesign.

GRADE LEVEL

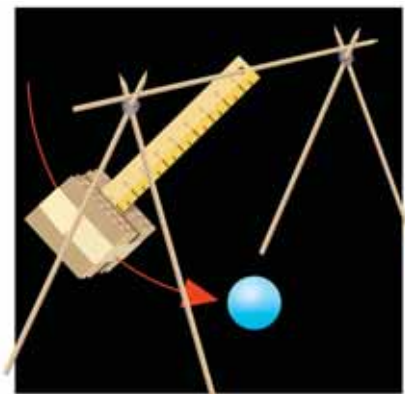
Middle school.

THE CHALLENGE

Build a machine that kicks a ping-pong ball into a cup lying on its side 12 inches away. Use either (1) a pendulum, (2) a rubber band, or (3) a combination of the two to do this.

DISCUSSION

When you lift a pendulum or stretch a rubber band, you increase its potential energy. Potential energy is energy that is stored. When you release the pendulum or rubber band, its potential energy is turned into kinetic energy, the energy of motion. Many machines have this in common—they turn potential energy (e.g., fuel, electricity, muscle power, springs, or weights) into kinetic energy that can be used to do a task (in this case, launch a ball).



MATERIALS

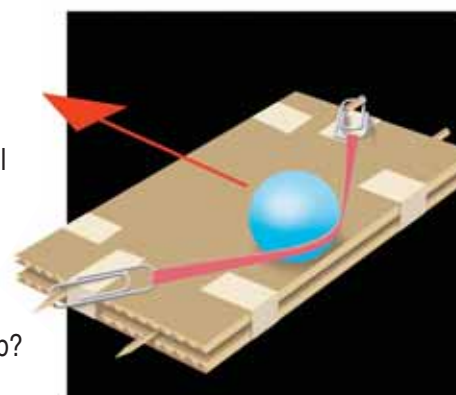
- Balls (Ping-Pong and golf)
- Corrugated cardboard
- Paper clips
- Paper cups
- Popsicle sticks
- Rubber bands
- Ruler
- Scissors
- String
- Tape (masking or duct)
- Thin metal wire (optional)
- Wooden skewers

Estimated time to complete: 60 minutes

BRAINSTORM AND DESIGN

Before the students begin designing their machines, have them brainstorm answers to the following questions.

- Will their machine use a pendulum or rubber band (or a combination) to send a ball into the cup?
- How will they stop the machine from launching the ball before they're ready to release it?
- How will the machine be triggered when launch is ready?
- How will they ensure the pendulum or rubber band launches the ball straight enough and with the right amount of force so it goes into the cup?



Ask the students to think about how to create different release points for the pendulum or rubber band in order to have more control over a launched ball. Also have them consider how to determine the right amount of energy to store up (potential) before making the launch (kinetic).

BUILD, TEST, AND REDESIGN

As students build their machines, take turns testing them. Lay a cup on its side 12 inches away and see if the ball is kicked in. Some problems to look for:

- the stretched rubber band might bend the frame.
- the pendulum and rubber band might slip and not stay pulled back.

Tell the students they must redesign to fix the problem so the machine works every time.

FURTHER EXPLORATION

- Move the cup so it's 24 inches from the kicking machine.
- Build a ramp and see if the machine can shoot the ball up and over the ramp.
- Build a machine that can launch two balls at once or that can launch balls at different speeds.



INSIDE THE ENGINEERING

Building machines that make tasty—and sometimes far-out—ice cream flavors is just the kind of challenge Pete Gosselin loves. He's head engineer for Ben and Jerry's® ice cream. Pete's the guy who designs the machines that make different flavors and mix the right amounts of candy, filling, or swirl into each container. And you thought getting a ball into a cup was a challenge! Some days, it's, "We want every container to have half a pint of cherry ice cream with cherries and fudge flakes and half a pint of chocolate ice cream with fudge brownies. Now on the brownie side, make sure there are at least three but no more than four brownie bites. Oh and by the way, these babies need to roll off the production line at 200 pints a minute." His biggest challenge: to design a machine that makes a flavor with a core of fudge and caramel wedged between chocolate and caramel ice cream. The way Pete sees it, "The world is full of problems and possibilities. And technology has a huge influence on making our lives better, whether the challenge is addressing global warming or making delicious food."

Watch Design Squad at www.pbskids.org/designsquad

TM © 2006 WGBH Educational Foundation. All rights reserved. Design Squad is produced by WGBH Boston.

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.



OBJECT

Students learn that in order to copy and cut a shape to fit something, they must use that shape's dimensions and other properties so the new shape matches the old shape exactly.

GRADE LEVEL

Elementary school.

THE CHALLENGE

Use a carpenter's square to cut a lid that fits exactly on top of a box.

TIE TO CYBERCHASE EPISODE In Unhappily Ever After, Jackie, Matt, and Inez have to figure out how to make square corners so that three box lids fit exactly, in order to seal forever the Book of Unhappy Endings.

MATERIALS

- carpenter's square, one per pair of kids
- scissors
- pencil
- glue
- precut tagboard pieces, at least one per box (for kids to measure and cut)
- crayons, markers, glitter glue (to decorate the boxes)
- tape or hinges (hinges optional -- available at craft stores)
- *boxes with lengths and widths less than 11 inches, tops removed (one box for each pair of kids)

*Tissue boxes, cereal boxes, and small-size shoeboxes work well. Estimated time to complete: 60 minutes.

DISCUSSION

Engineers and architects give builders a set of directions that shows how a building should be constructed (blueprint). Builders often have to work with irregularly shaped materials – leftover scraps of plywood or sheetrock, for example – when building things. They use carpenter's squares to make edges straight and corners square so what they make will fit where they want to put it. Measuring with a carpenter's square is an effective way to cut a shape to fit, and can be even more accurate than tracing it by hand.

ACTIVITY

Before the class period, measure the length and width of each box (you don't need the height) and write the dimensions on the bottom. Write these same dimensions on a scrap of paper to give to the pair who will be making the lid for that box. Cut several pieces of tagboard for each pair of kids. Make some of these irregularly shaped (without square corners). Be sure the pieces are larger than what is needed to cover the tops of the boxes. Set up workstations for each pair of students with all materials except for boxes.

Put A Lid On It!



Step 1: Share an example with the class where, without measuring, you had a hard time cutting something to fit onto or into something else. (For example: When cutting paper to line a drawer, you didn't measure how wide or long the drawer was, and the paper you cut was too wide and didn't reach the back of the drawer. Or you were cutting a shelf for a bookcase and you cut the right length for the shelf, but the corners weren't square.)

Ask: What could I have done to make this task easier and successful?

Step 2: Tell students that they are going to make special lids. The lids are special because they have to fit exactly so Hacker can't steal the Book of Unhappy Endings and create chaos in cyberspace. There's only one problem: they have to make the lids before seeing the boxes! Fortunately, though, you have been given the measurements for the box lids, and you know that each of the boxes has square corners. Ask: What are some ways we can solve this problem?

Step 3: Students work in pairs. Give each pair the paper scrap with their box measurements. Using the materials you've provided, have them measure and cut a lid for their box.

TIP: In some cases, lids may fall into their boxes. To help prevent this, have them cut along the outside of their lines on the tagboard.

As students work, invite them to share problems and successes so that others can benefit from their experience. Help with the use of the carpenter's square as needed. (See USING THE CARPENTER'S SQUARE* below for more.)

Step 4: When all the pairs have finished, give them their "magic" boxes to check that the lids fit. (Some pairs may need to re-design: make a second attempt.) Help attach the fitted lids (either with tape or with the optional hinges), and allow time for students to decorate both lids and boxes with the materials provided.

USING THE CARPENTER'S SQUARE

1. Draw a square corner on the tagboard with the carpenter's square. Make the two lines longer than the

length and width of your lid.

2. Measure and mark the width of your lid on one of the lines. Measure and mark the length on the other line.

3. Turn the carpenter's square and lay it along the vertical line you just drew. Make the corner of the carpenter's square line up with your mark on the line.

4. Holding the square in place, draw a line across the top. (Make it longer than you need for the lid.)

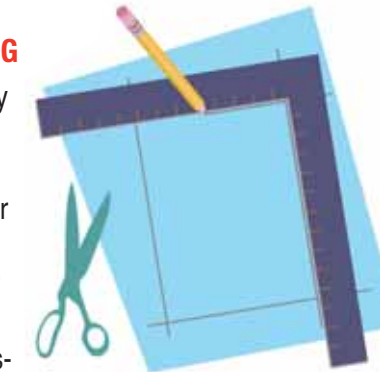
5. Turn the carpenter's square and lay it along the horizontal line you drew earlier. Make the corner of the carpenter's square line up with your mark.

6. Holding the square in place, draw a line to complete your lid.

*For tips on how to make your own carpenter's square, go to www.eweek.org/site/DiscoverE/activities/index.shtml

CONNECT TO ENGINEERING

Measurements are especially important to engineers and surveyors. How could they build a house – or a bridge or playground or jelly bean machine – without knowing how BIG or how SMALL to make it? Sometimes you can measure something directly. For example, on a flat lot for a new building, a surveyor could use a chain – one of their tools – or a long tape measure to mark the lot and where the house should be built. But if the lot isn't flat and is BIG, then the surveyor needs to find another way to do the measurements indirectly like the top for the smallest box. They use magnetic compasses to measure angles and math to measure distances that they couldn't do with just a tape. Semiconductor engineers – the people who design the computer chips in games – need to measure things that are less than one hundredth the thickness of a human hair. Astronomers who study the planets and stars measure distances in million and billions of miles or even further.



Build math skills with CYBERCHASE

Check local listings or visit www.pbskids.org/cyberchase.



CYBERCHASE is produced by Thirteen/WNET New York in association with Title Entertainment Inc. Major Funding for CYBERCHASE is provided by the National Science Foundation, Ernst & Young LLP, Northrop Grumman Corporation, PBS and the Corporation for Public Broadcasting. Additional funding is provided by The Volkhausen Family. CYBERCHASE (c) 2007 Educational Broadcasting Corporation. All Rights Reserved. The PBS KIDS GO! logo (c) 2004 Public Broadcasting Service. The PBS KIDS GO! logo and wordmark are service marks of the Public Broadcasting Service.

Ups and Downs in Design



The science behind how things move (physics) is of great importance to engineers.

Older students will gain a hands-on understanding of the basics of engineering design associated with kinetic and potential energy as they design, build, and test model roller coasters.

See www.eweek.org/site/DiscoverE/activities/index.shtml.

This activity provided by JETS (www.jets.org) and its partners The Engineering Pathway (www.engineeringpathway.org) and the TeachEngineering Digital Library (www.teachengineering.org).

More Resources

Junior Engineering Technical Society (JETS)

www.jets.org
Stocks guidance brochures for various engineering disciplines and administers the TEAMS test.

www.discoverengineering.org

The companion site to the new Discover Engineering DVD; middle schoolers, educators and parents have praised this site. Visitors can view portions of the video, skim general information and dig through rich content.

www.futurecity.org

Middle school students work with volunteer engineers to design future urban centers on the computer. They build scale models and compete in regional and national competitions.

www.tryscience.org and www.tryengineering.org

Both interactive sites give students a chance to explore science and engineering with virtual visits, activities, and design challenges.

www.engineeringk12.org

This is sponsored by the American Society for Engineering Education Engineering K12 Center. You'll also want to check out a new guide book to engineering and technology for high school students called "Engineering: Go For It."

www.engineeryoulife.org

A guide to engineering for high school girls, parents and counselors.



ENGINEERS WEEK 2008
February 17-23

National Engineers Week Foundation
1420 King Street, Alexandria, Virginia 22314
Visit our homepage at www.eweek.org

Engineers Week and Discover "E"

are made possible by the Engineers Week Committee, Corporate Affiliates, and these additional partners:

Corporate Sponsors
General Dynamics Advanced Information Systems
Tyco Electronics Corp.
Washington Group International

Corporate Contributors
Agilent Technologies, Inc.
ADC Foundation
ATK
Celestica
Eastman Chemical Company
FedEx Corporation
Parsons Brinckerhoff, Inc.

With Additional Support From
Caterpillar Inc.

Contributing Societies
American Institute of Aeronautics and Astronautics
American Nuclear Society
American Public Works Association
American Water Works Association

ASTM International
INCOSE Colorado - Front Range Chapter (International Council on Systems Engineering)
ISA – The Instrumentation, Systems, and Automation Society
Society of American Military Engineers
Tau Beta Pi Association, Inc.
The Minerals, Metals & Materials Society
United Engineering Foundation

With Additional Support From
National Academy of Engineering

Endorsers
AAACE International
ACI International
American Institute for Medical and Biological Engineering
American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc.
American Physical Society
American Railway Engineering and

Maintenance-of-Way Association
American Society for Engineering Education
American Society of Naval Engineers, Inc.
ASFE
ASM International
Biomedical Engineering Society
Engineers' Leadership Foundation
Environmental Industry Associations
Federation of Materials Societies
Global Wireless Education Consortium
INFORMS - Institute for Operations Research & the Management Sciences
Institute of Brownfield Professionals
Institute of Clean Air Companies
International Technology Education Association

JETS - Junior Engineering Technical Society
Laser Institute of America
MATHCOUNTS
Mathematical Association of America

NACE International
National Association of Women in Construction
National Council of Structural Engineers Associations
School Science and Mathematics Association
Society of Allied Weight Engineers
SPIE – The International Society for

Optical Engineering
Standards Engineering Society
Triangle Coalition for Science and Technology Education
Water Environment Federation

And Supported by the
National Council of Teachers of Mathematics

Engineers Week Coalition Diversity Council Founding Members

Chinese Institute of Engineers-USA, 2008 Diversity Council, Chair
American Association for the Advancement of Science
American Association of People with Disabilities
American Indian Science and Engineering Society
MentorNet
National Action Council for Minorities in Engineering

National Association of Multicultural Engineering Program Advocates
National Organization of Gay and Lesbian Scientists and Technical Professionals
National Society of Black Engineers
Society of Hispanic Professional Engineers
Society of Women Engineers
The National GEM Consortium
Women in Engineering Programs & Advocates Network