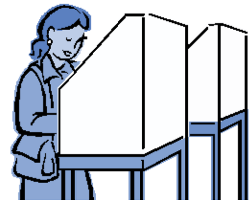
Cast Your Vote



Provided by TryEngineering - www.tryengineering.org

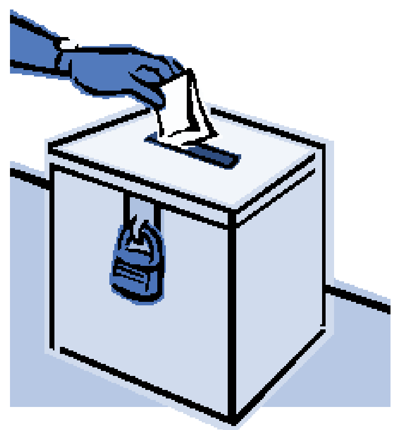
Lesson Focus
Lesson focuses on how technology and engineering can impact society, and how poll-taking has been influenced by engineering over time. Students design and construct a voting or polling machine out of everyday items, then test and evaluate the effectiveness of the design.

Lesson Synopsis
The "Cast Your Vote" lesson explores how voting systems have been changed due to engineering advances over time. Students work in teams to design their own voting system using easy to find materials. Student teams first design their voting system on paper, then construct it, test it, and evaluate the effectiveness of all the systems developed by student teams.

Age Levels
8-18.

Objectives

- Learn about engineering design.
- Learn about planning and construction.
- Learn about teamwork and working in groups.



Anticipated Learner Outcomes
As a result of this activity, students should develop an understanding of:

- mechanical engineering and design
- problem solving
- teamwork

Lesson Activities

Students learn how methods of voting have adapted over time using engineering to increase accuracy and privacy in voicing an opinion. Students work in teams to develop a voting system using everyday items. Teams plan their mechanical system, execute construction, troubleshoot, evaluate their own systems and that of other students, and present their findings to the class.

Resources/Materials

- Teacher Resource Documents (attached)
- Student Worksheets (attached)
- Student Resource Sheets (attached)

Alignment to Curriculum Frameworks

See attached curriculum alignment sheet.

Internet Connections

- TryEngineering (www.tryengineering.org)
- Improving U.S. Voting Systems (www.nist.gov/itl/vote/)
- International Association for Voting Systems Sciences (www.iavoss.org)
- Federal Election Commission (www.fec.gov)
- ITEA Standards for Technological Literacy: Content for the Study of Technology (www.iteaconnect.org/TAA)
- National Science Education Standards (www.nsta.org/publications/nses.aspx)

Recommended Reading

- Voting Technology: The Not-So-Simple Act of Casting a Ballot (ISBN: 0815735634)
- Point, Click and Vote: The Future of Internet Voting (ISBN: 0815703694)
- Electoral Engineering: Voting Rules and Political Behavior (ISBN: 0521536715)

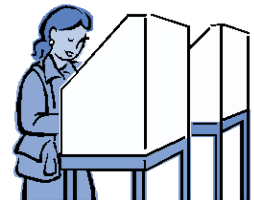
Optional Writing Activity

- Write an essay or a paragraph about how an accidental or deliberate power outage might impact the outcome of an election.

Optional Extension Activity

- Run a mock election in your school, voting on an issue such as how best to reduce the energy consumption of your building. Evaluate what factors such as attendance (who was attending and able to vote), promotion (posters, flyers, campaign materials, and the persuasiveness of those promoting different sides of the argument impact the results.

Cast Your Vote



For Teachers:
Teacher Resource

◆ **Lesson Goal**

The "Cast Your Vote" lesson explores how voting systems have been changed due to engineering advances over time. Students work in teams to design their own voting system using easy to find materials. Student teams first design their voting system on paper, then construct it, test it, and evaluate the effectiveness of all the systems developed by student teams.

◆ **Lesson Objectives**

- Learn about engineering design.
- Learn about planning and construction.
- Learn about teamwork and working in groups.

◆ **Materials**

- Student Resource Sheet
- Student Worksheets
- One set of materials for each group of students:
    - Cardboard box, card board sheets, scissors (supervised), paper clips, hole punch (hand held), paper, colored pencils or markers, highlighter pen, notebook (for recording results), non-toxic glue, string, cardboard tubes (such as from paper towel or toilet paper rolls), rubber bands, wire, aluminum foil, tape.

◆ **Procedure**

1. Show students the various Student Reference Sheets. These may be read in class, or provided as reading material for the prior night's homework.

2. Divide students into groups of 2-3 students, providing a set of materials per group.

3. Explain that students must develop their own working -- and consistently reliable -- voting system from everyday items.

4. Students meet and develop a plan for their voting machine. They agree on materials they will need, write or draw their plan, and then present their plan to the class.

5. Student teams may request additional quantities of any of the materials provided. Assume that each group will have to receive, record, and report at least 40 votes.

6. Student groups next build their machine. They may need to rethink their plan, request other materials, trade with other teams, or start over. This project may require overnight drying of glued segments before the voting begins phase.

7. Each student group also develops a topic for their poll or vote. It might be selecting a snack for a treat for younger students, selecting a book to be read for an assignment, or picking the theme for an upcoming study unit.

8. Teams then conduct their poll, gather the results and evaluate the result of the vote. All students should be expected to vote using the systems developed by other teams.
   Notes:

   a. The teacher may need to ensure that students are respectful of the systems built by others.)

   b. The machine or system must be able to accurately record the opinion of voters. When testing the system, voters will keep their own records of what they voted to be compared with the results achieved in each system. The teacher may choose to monitoring the process and determining the % accuracy of each system, or appoint a team of "monitors" to do this task.

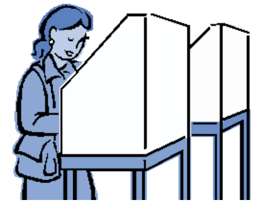
9. The teacher (or monitors) then present the accuracy findings to the class (% of votes accurately recorded).

10. Teams complete an evaluation/reflection worksheet, and present their findings to the class.

◆ Time Needed
Two to three 45 minute sessions

◆ Advanced Option
Have student teams develop a web-based or computerized voting system, using forms and pointing voting results into a database or email system.

Cast Your Vote



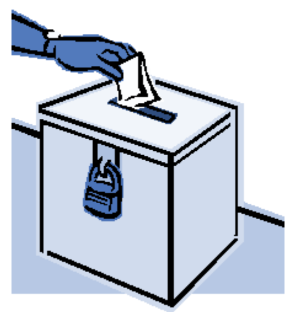
Student Resource: Voting Equipment through the Ages

Throughout history, society has needed to gather the opinion of groups of people. The earliest polling was likely verbal, but records were necessary to keep track of decisions made by groups. The first use of paper ballots to conduct an election appears to have been in Rome in 139 BCE, and the first use of paper ballots in the United States was in 1629 to select a pastor for the Salem Church. Disadvantages of this system included lack of privacy. Individuals may have felt required to vote one way or another and not voice their actual opinion.

◆ What is a Voting System?

A voting system is a combination of mechanical, electromechanical, or electronic equipment. It includes the software required to program, control, and support the equipment that is used to define ballots; to cast and count votes; to report and/or display election results; and to maintain and produce all audit trail information. A voting system may also include the transmission of results over telecommunication networks.

◆ Voting Boxes



Simple voting or polling boxes were developed into which people stuffed papers with their opinion indicated in writing. This improved the level of privacy associated with casting an opinion, but did not eliminate it, as handwriting can often give many clues as to who cast the vote. Also, if a standardized voting form was not used, the written information could be open to a variety of interpretations.

◆ Mechanical Voting (Punchcards)

Punchcard systems employ a card (or cards) and a small clipboard-sized device for recording votes. Voters punch holes in the cards (with a supplied punch device) opposite their candidate or ballot issue choice. After voting, the voter may place the ballot in a ballot box, or the ballot may be fed into a computer vote tabulating device at the precinct.

Two common types of punchcards are the "Votomatic" card (seen at right) and the "Datavote" card. With the Votomatic card, the locations at which holes may be punched to indicate votes are each assigned numbers. The number of the hole is the only information printed on the card. The list of candidates or ballot issue choices and directions for punching the corresponding holes are printed in a separate booklet. With the Datavote card, the name of the candidate or description of the issue choice is printed on the ballot next to the location of the hole to be punched. In the 1996 U.S. Presidential election, some variation of the punchcard system was used by 37.3% of registered voters in the United States.

◆ Mechanical Systems

Commonly used in the United States until the 1990s (and commonly known as lever machines), direct recording voting systems are mechanical systems to tabulate votes. Commonly, a voter enters the machine and pulls a lever to close the curtain, thus unlocking the voting levers. The voter then makes a selection from a list of switches indicating the candidates or opinion they choose. The machine is configured to prevent doubling of votes by locking out other candidates when one candidate's switch is flipped. When the voter is finished, a lever is pulled which opens the curtain and increments the appropriate counters for each candidate and measure.

◆ E-Voting

Now, many governments or organizations use computerized or e-voting to gauge the opinion of people on all issues from electing officials to determining community projects such as building a library or repairing roads. Touch screen systems can be adjusted to simplify and clarify the issues to be determined. Drawbacks can be glitches in the software, or loss of electronic data, which can impact the outcome of a poll. In addition, studies have shown that regardless of the technology involved, voters still make mistakes. A recent study indicated that accuracy rates dropped to the 80 to 90 percent range as the polling task became more complicated, such as voting for more than a single candidate in a race, voting a straight-party ticket or making corrections before casting the ballot. In addition, human nature can influence how any voting system works.

◆ The Human Factor

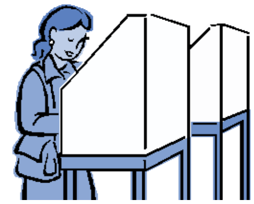
Many people do not like to ask for help. So, whether they are confused on how to pull a lever, punch a card, or use a touch screen, errors will still occur unless help is both requested and available.

◆ Other Considerations

Developers of reliable voting systems must take into consideration:

- How efficient is the system? How long it take for the average person to vote? Will there be enough time in one day for the population to cast their votes without long lines?
- Is the system accessible for physically challenged people?
- How will the system accommodate those who are physically unable to vote in person -- for example, those who are travelling to another country, in a hospital, or in a nursing home?
- How long will it take for the results to be shared with the population?

Cast Your Vote



Student Worksheet:
Build Your Own Voting Machine

You are a team of engineers who have been given the challenge of designing a reliable voting machine for your classroom. Your machine must be able to accept at least 40 votes, and accurately record the results.

◆ Research/Preparation Phase

1. Review the various Student Reference Sheets.

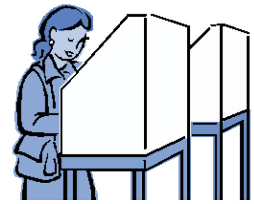
◆ Planning as a Team

2. Your team has been provided with some "building materials" by your teacher. You may ask for additional materials.

3. Start by meeting with your team and devising a design and materials plan to build your machine. Think about how the voter will interact with your design. Will it be sturdy enough to handle the votes of 40 people and still maintain accuracy? You'll need to figure out what building materials you require, and develop a sketch of your plan for review by your teacher. Remember, there is no "correct" design. Engineers come up with all sorts of designs to reach the same goal -- your design will be unique because your group did it!

4. Write or draw your voting system design in the box below or on another sheet. Include a list of materials you plan to use to build the instrument. Present your design to the class. You may choose to revise your teams' plan after you receive feedback from class.

Materials Needed:



Student Worksheet (continued):

◆ Construction Phase

5. Build your voting machine. Test it within your group to make sure it accurately records your own votes. Come up with a plan for recording the results.

◆ Cast Your Votes

6. Each student team will have a chance to vote on the other team's machines/systems. Be sure to respect the systems other teams have developed in the same way you want them to respect yours. As you vote on another machine, keep a record of how you personally voted on each issue.

◆ Evaluation Phase

7. Evaluate your teams' results, comparing your teacher's notes on what the votes were to those gathered in your system.
8. Complete the evaluation worksheet, and present your findings to the class.

◆ Use this worksheet to evaluate your team's results in the Cast Your Vote lesson:

1. Did you succeed in creating a voting machine that could accurately record at least 40 votes? What was your percentage of accurate votes? If you did not reach 100%, what caused the errors?

2. Did you need to request additional materials while building your machine?

3. Do you think that engineers have to adapt their original plans during the manufacturing process of products? Why might they?

4. How did engineers adapt voting machines over time? What prompted some of these changes?

5. If you had to do it all over again, how would your planned design change? Why?

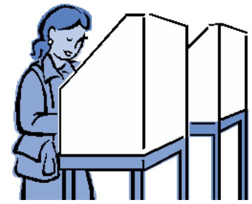
6. What designs or methods did you see other teams try that you thought worked well?

7. Do you think you would have been able to complete this project easier if you were working alone? Explain…

8. Can you think of a real world example of how an election has been influenced by the technology of the voting system?

9. Do you think internet voting is a good idea for national elections? Why or why not? (Think about security issues, tampering of votes, etc.)

10. What engineering considerations are needed in voting systems accommodate physically challenged voters?



For Teachers:
Alignment to Curriculum Frameworks

Note: Lesson plans in this series are aligned to one or more of the following sets of standards:

- U.S. Science Education Standards (http://www.nap.edu/catalog.php?record_id=4962)
- U.S. Next Generation Science Standards (http://www.nextgenscience.org/)
- International Technology Education Association's Standards for Technological Literacy (http://www.iteea.org/TAA/PDFs/xstnd.pdf)
- U.S. National Council of Teachers of Mathematics' Principles and Standards for School Mathematics (http://www.nctm.org/standards/content.aspx?id=16909)
- U.S. Common Core State Standards for Mathematics (http://www.corestandards.org/Math)
- Computer Science Teachers Association K-12 Computer Science Standards (http://csta.acm.org/Curriculum/sub/K12Standards.html)

◆National Science Education Standards Grades K-4 (ages 4 - 9)

CONTENT STANDARD A: Science as Inquiry

As a result of activities, all students should develop

- ✦ Abilities necessary to do scientific inquiry
- ✦ Understanding about scientific inquiry

CONTENT STANDARD E: Science and Technology

As a result of activities, all students should develop

- ✦ Abilities of technological design

CONTENT STANDARD F: Science in Personal and Social Perspectives

As a result of activities, all students should develop understanding of

- ✦ Science and technology in local challenges

CONTENT STANDARD G: History and Nature of Science

As a result of activities, all students should develop understanding of

- ✦ Science as a human endeavor

◆National Science Education Standards Grades 5-8 (ages 10 - 14)

CONTENT STANDARD A: Science as Inquiry

As a result of activities, all students should develop

- ✦ Abilities necessary to do scientific inquiry
- ✦ Understandings about scientific inquiry

CONTENT STANDARD E: Science and Technology

As a result of activities in grades 5-8, all students should develop

- ✦ Abilities of technological design
- ✦ Understandings about science and technology

CONTENT STANDARD F: Science in Personal and Social Perspectives

As a result of activities, all students should develop understanding of

- ✦ Risks and benefits
- ✦ Science and technology in society

CONTENT STANDARD G: History and Nature of Science

As a result of activities, all students should develop understanding of

- ✦ Science as a human endeavor
- ✦ History of science

◆National Science Education Standards Grades 9-12 (ages 14-18)

CONTENT STANDARD A: Science as Inquiry
As a result of activities, all students should develop
- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

CONTENT STANDARD E: Science and Technology
As a result of activities, all students should develop
- Abilities of technological design
- Understandings about science and technology

CONTENT STANDARD F: Science in Personal and Social Perspectives
As a result of activities, all students should develop understanding of
- Personal and community health
- Science and technology in local, national, and global challenges

CONTENT STANDARD G: History and Nature of Science
As a result of activities, all students should develop understanding of
- Nature of scientific knowledge
- Historical perspectives

◆Next Generation Science Standards Grades 3-5 (Ages 8-11)

Engineering Design
Students who demonstrate understanding can:
- 3-5-ETS1-1.Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2.Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3.Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

◆Next Generation Science Standards Grades 6-8 (Ages 11-14)

Engineering Design
Students who demonstrate understanding can:
- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

◆Next Generation Science Standards Grades 9-12 (Ages 14-18)

Engineering Design
Students who demonstrate understanding can:
- HS-ETS1-2.Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

◆Standards for Technological Literacy - All Ages

The Nature of Technology

- Standard 1: Students will develop an understanding of the characteristics and scope of technology.

Technology and Society

- Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.
- Standard 6: Students will develop an understanding of the role of society in the development and use of technology.
- Standard 7: Students will develop an understanding of the influence of technology on history.

Design

- Standard 8: Students will develop an understanding of the attributes of design.
- Standard 9: Students will develop an understanding of engineering design.
- Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Abilities for a Technological World

- Standard 13: Students will develop abilities to assess the impact of products and systems.

The Designed World

- Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.