The Phone Charger Conundrum

Provided by TryEngineering - www.tryengineering.org

Lesson Focus
Lesson focuses on how technical standards are developed and demonstrates how standards enable products to work together.

Lesson Synopsis
Teams of students will develop models of wireless phone chargers that are compatible with other teams' mobile device designs.

Age Levels
12-18

Objectives
Students will be able to:
- Define what a standard is
- Explain the role of standards in the development of technology
- Develop a standard for a product
- Work in teams to develop a product that complies with a standard

Anticipated Learner Outcomes
As a result of this activity, students should develop an understanding of:
- technical standards
- engineering concepts
- problem solving
- teamwork

Lesson Activities
Student teams learn how engineers work together to develop products that are compatible with other products.

Resources / Materials
- Teacher Resource Documents (attached)
- Student Worksheets (attached)
- Student Resource Sheets (attached)

Alignment to Curriculum Frameworks
See attached curriculum alignment sheet.

Internet Connections
- IEEE Standards Association (http://standards.ieee.org)
- American National Standards Institute (ANSI) (www.standardslearn.org)

Optional Writing Activity

- For younger students: Students can create a marketing sheet that explains all of the features of the phone their team designed.
- For older students: Students can create a product specifications sheet that includes information on elements such as: design, hardware, software and applications, communication, security, sharing and internet, navigation, photography, music and audio, video, environmental friendly features, accessibility etc.

Credits

Developed by the IEEE Standards Education Committee

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For Teachers:
Teacher Resources

◆ Lesson Objectives

Students will be able to:

- Define what a standard is
- Explain the role of standards in the development of technology
- Develop a standard for a product
- Work in teams to develop a product that complies with a standard

◆ Materials

- Plastic forks, writing paper, pencils, cardstock, construction paper, clear tape, glue sticks, scissors, markers, crayons, plastic wrap, aluminum foil, rulers, protractors

◆ Procedure

1. Show students two different devices that are not compatible (such as an iPhone and a Blackberry charger). Invite two students to come up in front of the class and try to charge the phone with the charger.
    - Ask students why they think the phone and charger don't work together, and what they think the solution is.
    - Invite students to share other examples of products that need to work together.
2. Review background material on standards as provided in the Student Resource sheets.
3. Divide students into teams of two to three.
4. Share with students that a brand new wireless phone charger known as the PowerFork has recently been developed. They have been selected to help develop the standard that will outline what is required for a phone to be compatible with the PowerFork.
5. Provide each team with a PowerFork (one plastic fork), so they can document its properties (shape, size, appearance etc.). As additional option, as a class you can come to a consensus on modifications to the PowerFork such as breaking off one or more of the tines before documenting its properties.
6. As a class, develop a standard explaining what is required to create a mobile phone that successfully plugs into the PowerFork. (e.g. how many holes does it need, how deep do the holes need to be, what is their diameter, how far apart must they be, are the holes straight or at an angle, are there any concerns regarding temperature since the PowerFork is plastic?)
7. Challenge each team of engineers to design a smart phone prototype out of the materials provided, that will be compatible with the PowerFork phone charger (based on the standard they developed).
8. When students have completed their designs, they can test compatibility with the PowerForks, tweaking as needed.
9. Students can then present their designs and test results to the class.
10. If you wish to evaluate students' designs, you can rate each team's design on a scale of 1-5 using each of the following criteria: original design, compatible design, and creativity

◆ Time Needed

- One to two 45 minute sessions

Student Resource:

◆ **What is a technical standard?**

A technical standard is a norm or requirement that establishes uniform engineering or technical criteria, methods, process and practices. A standard is usually a formal document that spells out a specific set of requirements for an item, material, component or system.

Standards influence virtually everything, such as computers, phones, communication systems, power and energy, tools, transportation, medical devices, safety, and even toys.

Standards help enable products made by different companies to work together. For example, below is a picture of a wireless router and a laptop computer. You may have one in your home or school. **IEEE Standard 802.11** enables your computer to connect to the wireless router to get online even though both devices are made by different companies.

Below is an example of something that is standardized at a national or regional level, but not on a global level. What happens when you travel to a different country and your phone charger doesn't fit into the plug? This is a very good illustration of why technical standards can help make life easier.

For advanced discussion / older students: Standards may be voluntary, where manufacturers can choose to utilize the standard. Standards may be established as procurement guidelines by major buyers, which can provide a significant incentive for manufacturers to adopt the standards. Standards may also be established as regulatory or legal requirements so non-conforming products would be unlawful.

Discussion questions:

- Why might a manufacturer choose not to implement a standard? [answers include: will not work with their device, they feel they have a better idea, and for this example they want to make an increased profit off of a unique design – ideally patent protected so no other supplier can compete with that item.]

- Using the example of the electrical outlets above, why do you think there might be standards at a national or regional level, but not on a global level? One aspect might be that there are trade barriers that protect local markets for appliances.

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Student Worksheet:

◆ Engineering Teamwork and Planning

A brand new wireless phone charger known as the PowerFork has recently been developed. You are part of a team of engineers that has been selected to help develop a new mobile phone that is compatible with or works with the PowerFork.

Once you receive your PowerFork, document its properties including (shape, size, length of tines, distance between tines, appearance etc.)

As a class, you will decide what is required to make the mobile phone that you design fit with the PowerFork.

Your phone can be any size, shape or have any features you wish, as long as it fits your PowerFork and everyone else's. Not only does your phone need to be functional, but it also needs to be attractive to users. You will a build your prototype out of the simple materials provided, and then test your design.

◆ Planning and Design Phase

Sketch your design ideas below. Include measurements.

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Student Worksheet:

◆ Construction Phase

Build your phone and test it to see if it plugs into the PowerFork perfectly. If yes, go to other teams and test whether it fits with their PowerFork.

◆ Presentation and Measurement

Present your mobile phone design and the results of your testing to the class.

◆ Evaluation

Complete the evaluation questions below:

1. How similar was your design to the actual mobile phone you built?

2. Were you able to design a phone that was compatible with the PowerFork? Was it compatible with other teams' PowerForks?

3. Did it work the first time, or did you need to make any modifications? Describe why your team decided to make revisions.

4. What was special or different about your phone, which in your opinion, made it better than others?

5. What is one thing you have learned about standards after participating in this activity?

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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

- ✦ Understanding about science and technology

◆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, 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

- ✦ Science and technology in society

◆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

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For Teachers: Alignment to Curriculum Frameworks

◆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.

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

Engineering Design

- 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.

◆Standards for Technological Literacy - All Ages

The Nature of Technology

- Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

Technology and Society

- Standard 6: Students will develop an understanding of the role of society in the development and use of technology.

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 11: Students will develop abilities to apply the design process.

The Designed World

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