TURNING IDEAS INTO REALITY: ENGINEERING A BETTER WORLD
Facilitator Guide
Assistive Device

Prior to Facilitating Activity

- Carefully read the facilitator guide and PowerPoint presentation. Skim the full activity description
- Check kit to ensure all of materials needed for the activity are included (see material list taped to lid of kit). If not, please see Beth Hart in KL261 or call 937-229-5080.
- Contact teacher to:
  - Confirm the time and location where you will be facilitating this activity.
  - Confirm the length of time you will have to facilitate the activity.
  - Make sure you have completed all necessary training and/or background checks with the teacher(s).
  - Confirm any sign in policies, dress code requirements, etc.
  - Provide the teacher with your phone number, so she/he can reach you if needed.
  - Confirm technology available in the classroom. Many activities include YouTube videos; therefore, confirm that the school's network will not block them.
- Check the kit's memory stick for the activity's PowerPoint presentation by opening it on your personal computer.
- School technology is not always reliable, so take your personal computer for back up if needed.
- Divide materials into prepared sets for each team.

Day of Design Challenge Activity

- Arrive at school at least 15 minutes prior to your time scheduled to facilitate the activity.
- Connect projector and download PowerPoint from memory stick.
- Check that all technology is working (speakers, projection, etc.).
- Set-up as needed for the activity.
- Facilitate activity as indicated below.
- After activity, please cleanup, give the teacher feedback form to the teacher and ask him/her to fill it out (request it be completed before you leave), fill out facilitator feedback form.
- Return kit, pre/post-activity student surveys, teacher feedback, and all other forms to Beth Hart at KL261 (please note: pre and post-surveys may need to be eliminated if there is very short for facilitating the activity).

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Facilitator Tips

- Always keep in mind that your first priority is to have fun with the children!
- Introduce yourself to the students (remind them you are normal!):
  - Name
  - Major
  - Where you are from
  - What you like to do for fun or a club or activity you are in at school
- As you go through the PowerPoint, be sure to engage the students in discussion by asking lots of questions rather than just presenting information.
- Make sure students know what materials they have to construct their design, any time constraints and how the design will be tested (this information should be in PowerPoints)
- Resist the temptation to let the students skip the individual and team brainstorming steps. They will most likely want to jump right in to building the design; do not let them. It is important that they experience brainstorming and designing, as they are crucial engineering elements. Before allowing teams to work with materials, require them have you approve their sketch of the team's prototype design idea.
- As the students are building their prototypes, walk around the room and ask them probing questions about their design. For example:
  - What are your reasons for selecting that material?
  - How did you combine your individual design ideas?
  - Suppose a company decided to use your team's prototype as a model for an actual product they plan to produce. How effective do you think it would it be in solving someone's problem?
- Encourage teams to "test" components of their prototypes as they build them.
- Point out aspects of their design that impress you.
- Whether the design works or not, ask what modifications could be made in order to improve its effectiveness.
- Be sure students understand that failure is normal in engineering, which is why engineers use readily available, cost-effective materials when initially designing and testing a prototype idea. True failure occurs only when the designer is not persistent in brainstorming ways to improve their design.
- Ask students:
  - What do you like best about your design?
  - What do you like least about your design?
  - What aspects of other team designs stood out to you, and/or gave you ideas for improving your own team's design?
  - What modifications would you make if we had time to complete the design challenge again?

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- Do not allow students to criticize each other and try to get the "shy" or quiet students involved. This can be achieved by explaining that crazy/unachievable ideas frequently lead team members to think more creatively, which results in a better final design.

Activity Time Frame and Overview

Activity	Time	Overview
Introduction	*2 minutes*	Introduce Yourself Provide Brief Activity Overview to Foster Excitement
Pre-Assessment	*3 minutes*	Administer Kit's Pre-Activity Survey
Design Challenge Introduction	*10 minutes*	Begin PowerPoint Presentation: ● Guide Discussion ● View Video (2m38s) ● Present Detailed Problem/Scenario & Challenge ● Introduce Available Materials ● Explain Engineering Design Process
Individual Brainstorm	*5 minutes*	Team Members Individually: ● Brainstorm Ideas ● Write or Sketch Ideas to Share with Team
Prototype Design and Construction	*20 minutes*	Teams Collaboratively: ● Discuss Individual ● Choose and Sketch Final Idea for Approval ● Construct their Team Prototype
Testing and Reflection	*10 minutes*	Perform and Observe Prototype Testing Prototype Design and Testing Results Reflection
Conclusion	*2 minutes*	Wrap Up Discussion
Post-Assessment	*3 minutes*	Administer Kit's Post-Activity Survey

Materials List

Material	Quantity per Team	✓
Paper Clips	2	
Rubber Bands	6	
Construction Paper	1 sheet	
String or Yarn	2 feet	
Masking Tape	4 inches	

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Binder Clips	2	
Pipe Cleaners	4	
Safety Pins	3	
Plastic Forks	2	
Craft sticks	3	
Memory Stick *(With power point and handouts)*	~	
Pre-Activity Survey	1 copy *(per student)*	
Post-Activity Survey	1 copy *(per student)*	
Paper *(For brainstorming)*	6 sheets	

Set-Up

- Designate space for displaying and gathering available materials.
- Designate space for each team to collaborate and build their design ideas. Also, make sure all students will be able to see the presentation.
- Designate space for design testing. Make sure there is room for all students to observe.

Team Size

3-4 students (no student should work individually)

Design Challenge Scenario

You have a friend with limited hand and wrist muscle control, making the simple daily task of putting on socks difficult. You know there has to be a way to help your friend solve this problem. You begin thinking about and researching the process of putting on socks, and write the following notes.

- To complete any task, muscles must have potential (waiting) energy that is transformed (changed) into kinetic (moving) energy.
- When putting a sock on, muscles pick up and lift the sock, giving it **gravitational potential energy waiting to transform into kinetic energy** and fall to the ground.
- When putting a sock on, muscles stretch the sock, giving it **elastic potential energy waiting to transform into kinetic energy** and move close to the body.
- The problem must be that your friend's muscles do not have enough strength to control the sock's gravitational potential energy and elastic potential energy.

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Engineering Design Challenge

Pulling on a sock is difficult for people with limited hand and wrist muscle control. It is a struggle for their muscles to overcome the sock's elastic potential energy when stretched, and gravitational potential energy when lifted.

Now that you know the cause of the problem, you decide to take on the challenge of designing a solution! Your challenge is to use only the materials available to design and build a device prototype that can help people pull on their socks independently.

Step-by-Step Facilitator Instructions

Note: The activity's PowerPoint presentation guides instruction and visually presents information to students. Therefore, the instructions include corresponding slide numbers.

1. Slide 1: As the pre-activity survey is distributed to students, introduce yourself and provide enough of an activity overview to gain students excitement.
2. Allow time for students to individually complete their pre-activity survey.
3. Divide group into teams of 3 or 4 students.
4. Slides 2 and 3: Discuss engineering and what engineers do.
5. Present the engineering design problem and challenge, following presentation:
   - Slide 4: Play video (2m38s).
   - Slide 5: Present the real-world engineering design problem (scenario).
   - Slide 6: Introduce the Engineering Design Challenge.
   - Slide 7: Share Engineering Design Goals.
   - Slide 8: Introduce resources (materials) available to each team.
   - Explain how teams will work.
   - Slide 9: Explain prototype-testing procedures.
6. Slide 10: Introduce the Engineering Design Process. Explain that engineers use it as a tool to help them more effectively solve problems.
7. Slide 11: Explain how teams will use the engineering design process as they complete the challenge.
   - Brainstorm:
     - Each individual in a team must write or sketch one or two ideas.
     - Team must discuss each idea.
     - Team decides criteria most important to them while keeping constraints (limited time and materials, etc.) in mind.
   - Create Team Prototype:
     - Teams choose, sketch, and outline their prototype design idea.
     - Teams have idea approved by facilitator.
   - Gather Materials:

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    - Teams receive their bag of materials (prepared in advance).
  - Create Chosen Design:
    - Team creates their approved prototype design plan.
  - Final Test:
    - Each team tests their prototype while other teams observe.
8. Slide 12: Facilitate a whole group reflection on final prototype design and testing results by asking questions such as the following.
   - What do you like best about your design?
   - What do you like least about your design?
   - What aspects of other team designs stood out to you, and/or gave you ideas for improving your own team's design?
   - What modifications would you make if we had time to complete the design challenge again?
   - How challenging was it to pull the sock onto the foot?
   - Do you think it would be more or less challenging to pull the sock onto your own foot?
9. Slide 13: Conclude by discussing the following questions as post-activity surveys are distributed.
   - What ideas do you have for engineering a better world?
   - How can you turn ideas into reality?
10. Allow time for students to complete their post-activity survey.

Prototype Building - Notes

Students may use only the materials provided. The device must be built separate from the sock (sock cannot be part of the design; it must be able to attach to and detach from the sock), and must be completed within the time given.

Prototype Testing - Notes

Design will be tested using a mannequin foot. Students must design a device that can be attached to a sock right before testing. The device will be used to help someone pull a sock onto the mannequin foot. Have students think about how easy it was to pull the sock onto the mannequin foot, or would it have been easier to their own foot.
Note: the design cannot be built on the sock. It must be something that can be attached during testing and detached after testing.

Follow-up / Reflection - Notes

Use this time to ask the students what they liked best about their design and what they would change about their designs. You can also relate the specific activity to a type of engineering. Ask the students if they have any ideas as to what type of engineer might design this item. If

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you have done something similar through co-op or a class project, share your experiences (in simple terms) with the students. Celebrate everyone's design by having the class applaud for that team after that team shares their design. Thank the students and teacher for their time, collect any post-tests or forms.

Background Information / Additional Resources

For an assistive device example see: NSF 2002 Engineering Senior Design Projects to Aid Persons with Disabilities (pages 137-137: "THE SOCKMATE: AN ASSISTIVE DEVICE THAT HELPS PEOPLE PUT ON THEIR SOCKS" http://nsf-pad.bme.uconn.edu/2002/Buffalo.pdf

- **Scientific Vocabulary**
  - Elastic Potential Energy – energy of materials in a state of being stretched or twisted
  - Friction –the force that opposes the motion of two surfaces in contact with each other
  - Gravity – the force that exists between objects due to their mass
  - Kinetic Energy (KE) – energy that a moving object has because of its motion
  - Potential Energy (PE) – the stored energy of an object due to its position or condition
  - Transfer – to move from one place to another
  - Transform – to change from one form into another

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