TURNING IDEAS INTO REALITY:
ENGINEERING A BETTER WORLD
Facilitator Guide
Cracker Catapult

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?
  - Why did you choose that design?
  - How did you create the idea for this design?
  - 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

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improving your own team's design?
    - What modifications would you make if we had time to complete the design challenge again?
- 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 Timeframe and Overview *(50 minutes)*

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 and Show Video (2m) ● Present the Engineering Design Challenge ● Explain the Engineering Design Process
Individual Brainstorm	*2 minutes*	Team Members Individually: ● Write Solution Ideas on Post-It Notes
Prototype Design and Construction	*15 minutes*	Teams Collaboratively: ● Discuss Individual Ideas ● Choose and Sketch Final Idea for Approval ● Gather Materials and Construct Team Prototype
Testing	*10 minutes*	Perform and Observe Prototype Testing
Conclusion	*5 minutes*	Relate to Engineering; They Did What Engineers Do Connect to Types of Engineering
Post-Assessment	*3 minutes*	Administer Kit's Post-Activity Survey

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.

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- Separate the materials into the right amounts per team. Set them out where they can be seen but wait to give them to students until after they brainstorm.

Team Size

4 students, maximum, per team

Design Challenge Scenario

An earthquake in Hawaii has collapsed the only bridge leading into or out of a town. The town's people are stuck, and in need of supplies! In order to transport supplies over the collapsed bridge, the neighboring town built a catapult and is flinging materials from one side to the other! A great amount of force is being applied to the materials in order to transfer enough kinetic energy and speed for them to make to the other side. Many supplies are being damaged because their high speeds and amount of kinetic energy causes them to hit the ground with great force.

Engineering Design Challenge

Your team's challenge is design a way to safely transfer the potential energy in the catapult to kinetic energy in the crackers without crackers breaking upon impact. Your design can include only the materials provided.

Note: For older students, an additional requirement can be added: The team that uses the least materials and ends with the most unbroken crackers wins the design challenge.

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.
Prep Work: Separate the materials into the right amounts per group.

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 2 to 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 (1m, 12s).
   - Slide 5: Present the real-world engineering design problem (scenario).
   - Slide 6: Introduce the Engineering Design Challenge, stressing that each team will only receive on packet of crackers and they have to be careful not to break them.
   - Slide 7: Play the video (2m19s), and have teams follow instructions to quickly build a catapult.

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- Slide 8: Display the visual instructions for building a catapult as teams finish their catapults.
- Slide 9: Share Engineering Design Goals.
- Slide 10: Introduce resources (materials) available to each team.
- Slide 11: Explain prototype-testing procedures.

6. Slide 12: Introduce the Engineering Design Process. Explain that engineers use it as a tool to help them more effectively solve problems.
7. Slide 13: Explain how teams will use the engineering design process as they complete the challenge.

   Imagine *(10 min.)*
   - INDIVIDUALLY: observe available materials, and brainstorm and write design ideas *(5 min.)*
   - TEAM: share individual ideas *(5 min.)*

   Plan *(5 min.)*
   - Choose and sketch a team design plan

   Create *(10 min.)*
   - Gather materials
   - Construct your team design plan

   Improve and Test *(10 min.)*
   - Teams decide on and make any last minute improvements before testing
   - Each team tests their prototype while other teams observe.
     If the crackers do not break on the first round, elevate the catapult and do a round two if time permits! This time the catapult should be placed on a table in a position where the cracker will be launched off the table to the floor (at least a 3 foot drop).
8. Slide 14: 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?
9. Slide 15: 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.

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Prototype Building - Notes

It is recommended to build the catapult yourself, so you can use your model to help others if they have trouble.

Prototype Testing - Notes

To test the catapult and impact cushioning system, have the students fire the catapult. If the cracker travels more than a foot and does not break the design is said to be successful. If the crackers do not break on the first round, elevate the catapult and do a round two if time permits! This time the catapult should be placed on a table in a position where the cracker will be launched off the table to the floor (at least a 3 foot drop).

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 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

The concepts of kinetic and potential energy are important for this problem. The challenge is design a way to safely transfer the potential energy in the catapult to kinetic energy in the crackers without crackers breaking upon impact.

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