TURNING IDEAS INTO REALITY:
ENGINEERING A BETTER WORLD
Facilitator Guide

Save the Building

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 PowerPoint)
- 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?

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- 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?

- 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.

Timeframe: (53 minutes)

Activity	Time allotment	Description
Ex - pretest	5 minutes	Hand out and administer the pretest provided in the kit
Introductory power point	2 minutes	Go through the introductory power point that describes what engineers do
Introduce scenario and watch video	3 minutes	Describe scenario, watch video in PowerPoint
Share design goals and introduce materials.	2 minutes	Share design goals- build a design that protects the building, must be built in time given, can only use materials provided and within limits given. You will have: Wooden craft sticks, masking tape, duct tape, straws, foam plate, cardboard, foam cups, Crayola modeling clay, foil, Lego blocks, toothpicks.

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Share how design will be tested.	2 minutes	Students will builds their design. Three groups will then bring their designs to the testing tin where the houses are set up. They will then watch as the facilitator mixes the ingredients for the lava foam (on lid of kit as well as following this.) The facilitator will mix the reaction and advise students to step back and observe. The designs will be evaluated based on the level of protection their design provided from the lava flow. A design is successful if it protects the house entirely from the lava. Designs can also be evaluated based on the relation of which design was most successful of the three being tested at the same time. The groups will continue to be tested in groups if three until all groups have tested their design. Place the houses in the tin spread apart in marked three areas or about six inches apart. Have groups place their design where they determine would be the best spot to implement their design.

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Share engineering design process	3 minutes	Don't let the students get their materials until they have their designs, adjust times and process as needed
		Explain how groups will work.
		*At least groups of two - no one works alone.
		*Groups must work together in creating ideas and design.
		Create and improve
		• May need multiple test sites set up depending on group size
		• Final test
		  • May need multiple test sites set up depending on group size
		  • Have each group showcase how their design works
		  • Test three groups at a time
		Probing questions for discussion –
		• Does the placement of the design make a difference on how the design works?

Brainstorming	3 minutes	Each person in each group must come up with one or two ideas. Group must discuss each person's ideas Decide on idea using criteria: what is most important to them what is least important to them what are they restricted by

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Creating the idea	2 minutes	Draw and outline the idea get idea checked to move forward
Gathering Materials	1 minute	Collect materials put together by facilitator.
Create your design	15 minutes	test your design
Final Test of your design	10 minutes	observe your final product write what went well what could/would you change? if your product work how could you make it better? how did it work compared to other groups?
Concluding presentation	5 minutes	Compare to engineering presentation PowerPoint Relate their process to engineering process Show how they did what engineers do Tell them they had fun and they were all good at it What types of engineering this topic relates to?

Set-Up

Lay out testing area with houses in the pan on designated x's or about six inches apart from one another. Set up materials that will be necessary for testing of the activity with three groups at a time per how many people are in a classroom… (NOTE: Six groups in a class, two times materials to make foam paste).

Team Size

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3-4 students

Design Challenge Scenario

Mount. St Helens is erupting shortly. Your task is to create a structure that will save the surrounding building before the lava places the civilians in danger. You have around 15 minutes to complete the task, and save everyone.

Engineering Design Challenge

Have students use the engineering design process to create a design that will divert the lava/foam, using the materials given, in the time given, to save the building from the flow. How can they most successfully divert or block the lava foam flow to save the building?

Step-by-Step Facilitator Instructions

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. Set up testing area with the pan and have materials for toothpaste ready and organized.
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 (1m 49s).
- 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

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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:
  - 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?

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.

They will then watch as the facilitator mixes the ingredients for the lava foam (on lid of kit as well as following this.) The facilitator will mix the reaction and advise students to step back and observe. The designs will be evaluated based on the level of protection their design provided from the lava flow. A design is successful if it protects the house entirely from the lava. Designs can also be evaluated based on the relation of which design was most successful of the three being tested at the same time. The groups will continue to be tested in groups if three until all groups have tested their design.
Place the houses in the tin spread apart in marked three areas or about six inches apart. Have groups place their design where they determine would be the best spot to implement their design. End presentation sharing probing discussion questions.

Prototype Building - Notes

Students should find their own way to protect the building. The design cannot be bigger than six inches long when sitting flat.

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Prototype Testing - Notes

Students will build their design. Three groups will then bring their designs to the testing tin where the houses are set up. They will then watch as the facilitator mixes the ingredients for the lava foam (on lid of kit as well as following this.) The facilitator will mix the reaction and advise students to step back and observe. The designs will be evaluated based on the level of protection their design provided from the lava flow. A design is successful if it protects the house entirely from the lava. Designs can also be evaluated based on the relation of which design was most successful of the three being tested at the same time. The groups will continue to be tested in groups if three until all groups have tested their design.

Place the houses in the tin spread apart in marked three areas. Have groups place their design where they determine would be the best spot to implement their design.

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

Video - https://www.youtube.com/watch?v=UK--hvgP2uY

Foam Paste- http://www.sciencebob.com/experiments/toothpaste.php

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