TURNING IDEAS INTO REALITY:
ENGINEERING A BETTER WORLD
Facilitator Guide

Zip Line

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?
  - 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 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 - **must be ended abruptly at 1m14s** ● 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

Materials List

Material	Quantity per Team	✓
Straws	5	
Masking Tape	3 in	
String *(for team designs & for 1 zip line used to test designs)*	1 foot *(per team)* 4 feet *(for zip line)*	
Toothpicks	8	
Duct Tape	2 inch	

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Paperclips	3	
Pipe Cleaners	2	
Wooden Craft Sticks	4	
Ribbon	5 inches	
Rubber Bands	5	
Cups	1	
Lego People	1	
Scissors *(to cut duct tape)*	~	
Memory Stick *(With power point and handouts)*	~	
Pre-Activity Survey	~	
Post-Activity Survey	~	
Cardstock	1 sheet	
Paper *(For individual brainstorming)*	1 sheet	
Paper *(For team design sketch)*	1 sheet	

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 setting up the zip line to test designs. Make sure there is room for all students to observe.
- Prior to using the kits, divide materials into group amounts for teams as noted on the materials list.
- Before students come into the room set up the zip line for testing. THIS IS VERY IMPORTANT! It will keep students from trying to get additional materials.

  Set-up the zip line so that it is:
  - On a steep slope.
  - 3 – 4 feet in length.
  - Taught, with no slacking or sagging.
- Test the zip line's length and slope; making sure it is efficient for student test use.

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Team Size

3 – 4 students per team (no student works alone)

Design Challenge Scenario

A recent earthquake has collapsed a bridge, which was the only way out of an island. The islanders are running out of resources quickly, and need help. Your engineering team has concluded that the best and safest option is to transport the people off the island. The water's current is currently too strong, making it an unsafe means of transportation. The only means of transportation remaining is the island's famous zip line, which includes a section leading from the island to a neighboring city.

Engineering Design Challenge

Your team's challenge is to design and build a cradle that will safely transport one islander at a time across the zip line from the island to the neighboring city.

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 to 4 students each.
4. Slides 2 and 3: Discuss engineering and what engineers do.
5. Present the engineering design problem and challenge, following the presentation:
   - Slide 4: Show "Zipline Rescues from Mexico Floods" video –

     NOTE: Video must be ended abruptly at 1m14s.

   - Slide 5: Present the real-world engineering design problem (scenario).
   - Slide 6: Introduce the Engineering Design Challenge.
   - Slide 7: Discuss Engineering Design Goals.
   - Slide 8: Introduce resources (materials) available to each team.
   - 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:

   Imagine *(10 min.)*

   - INDIVIDUALLY: observe available materials, and brainstorm and write design ideas *(5 min.)*

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- 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
- Start with only one push from the top of the zip line
- Ensure the zip line has a steep slope
- Design must make it to the bottom of the zip line, holding Lego people throughout

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?
   - Do you think that changing the slope (angle) of the zip line would make a difference?
   - How did transformations between potential energy and kinetic energy force your design to move along the zip line?
   - What role did friction play on the safety and speed of your design as people were transported along the zip line?
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 Testing - Notes

Design will be tested using the zip line set-up (see "Set-Up instructions above) by the facilitator ahead prior to beginning activity. Students must contain/cradle one Lego person and make it to the bottom of the zip line. Only one push from the top may be used to begin a design's motion. If team's design passes, they may modify their existing design or reconstruct a new one, if time permits. Consider adding additional constraints (such as not using a material that was used in initial design, adding costs to items, transporting more Lego people, etc.). If a team's design fails, they may redesign and test again, if time permits.

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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. – Compare to PowerPoint.

Background Information / Additional Resources

Be sure to read through the activity's accompanying PowerPoint presentation and instructions on the Main File. Familiarize yourself with how a zip lines operate and how they cause energy to be transformed between potential and kinetic energy. Also read through the activity's Main File Academic Content Standards section to gain understanding of learning expectations at each grade level. Prior to facilitating the activity, test the zip line's length and slope; making sure it is efficient for student test use.

References

This activity has been adapted from the Rescue Rover and Conveyor Belt activities provided from tryengineering.com.

Conveyor Engineering - http://www.tryengineering.org/lesson-plans/conveyor-engineering

Rescue Rover - http://www.tryengineering.org/lesson-plans/rescue-rover

Zipline rescues from Mexico floods. *NBCNews.com*. NBC nightly news, 18 Sept 2013. Retrieved from: http://www.nbcnews.com/video/nightly-news/53044233#53044233.

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NBC Nightly News

Smooth Operator Presentation by Margaret Pinnell, PhD.

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