Activity 2:

Team Machine

Overview

This classic “icebreaker” activity challenges participants to create a simple human machine. A group of at least 6 and up to 20 people work together to pass a beanbag in a set pattern as quickly as possible. Participants rearrange themselves to achieve faster speeds. The social nature of *Team Machine* allows participants to experience how engineers often work in teams, with different people contributing in different ways, to take on a challenge. Some groups may address the challenge by creating an inclined plane with their hands — or for even faster speeds, a screw-shaped slide. These solutions provide the opportunity for discussion about where these simple machines are found in community parks: as playground slides!

Activity Time:

15 to 30 minutes

Intended Audience:

Families or other mixed-age groups, including children ages 5–7 *with assistance from an older child, teen, or adult*
School-aged children ages 8–9
Tweens up to about age 14

What’s the Point?

- Engineering is a social endeavor. Engineers often work in teams, with different people contributing in different ways, to take on a challenge. Engineers build on the ideas of others.
- Participating children, tweens, and adults, like engineers, can work together through the creative process of thinking, building, testing — and doing it again! — to build a fun simple machine.
- Inclined planes and screws are types of simple machines that can be used to lift loads using less energy than lifting them directly. Loads can also be moved quickly *down* an inclined plane or screw — such as on straight or “twisty” slides at the playground!

Materials

For the Facilitator

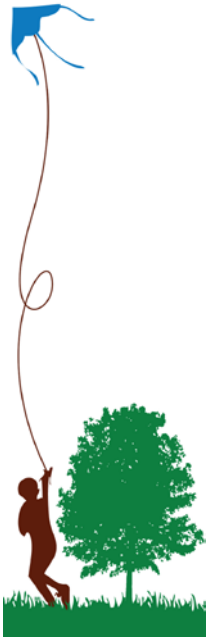
- ☐ *Implementation Guide* (available at www.starnetlibraries.org), which includes:
  - ☐ *Playful Building's* key features
  - ☐ Annotated facilitation outline
  - ☐ Facilitator background information
  - ☐ Shopping list
  - ☐ Extended supporting media suggestions
  - ☐ Correlations to National Science Education Standards
  - ☐ Contact information
  - ☐ STAR_Net project overview
  - ☐ Credits and acknowledgments
- ☐ *Brief Facilitation Outline* page
- ☐ *Playful Building* PowerPoint presentation (or the instruction slides printed for the groups to use) (available at www.starnetlibraries.org)

Facility Needs

- ☐ A (10' × 10') area where six to eight people can stand, crouch, and sit
- ☐ Optional: 4–6 chairs for those who need to sit to participate in this activity
- ☐ Optional: computer, speakers, projector, projection screen, and access to the Internet

For Each Large Group of 6–20 Participants

- ☐ 1 bean bag (or other small, soft object)
- ☐ 1 stopwatch
- ☐ 1 (8½" × 11") *Be Creative…Be an Engineer!* poster (for tweens, teens, and adults), preferably printed in color



Supporting Media

Consider setting up a digital media player (such as a computer), speakers, and access to the Internet to display videos, images, podcasts, or websites before, during, or after the activity.

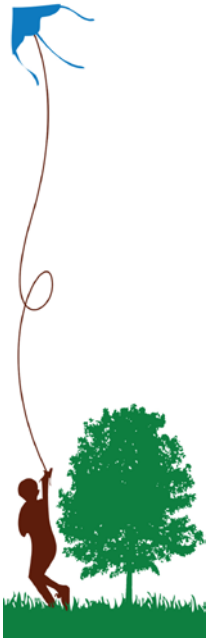
A more extensive list is included in the *Implementation Guide*.

Online Resources

Engineer Your Life: Civil Engineer Erin Fletcher
www.engineeryourlife.org
This guide to engineering offers videos, photos, career stories, and personal "tidbits" for each of 12 engineering professionals. For example, Erin Fletcher enjoys managing the diverse talents on her team as they work to develop bridges and barriers that reduce traffic noise — taking both the technical aspects, as well as the aesthetic, environmental, political, and community needs, into account. Appropriate for ages 8 and up.

Grand Challenges for Engineering
www.nae.edu/Activities/Projects/grand-challenges-project/Videos_grandchallenges.aspx
National Academy of Engineering videos provide insights into the Grand Challenges for Engineering, and include interviews with engineering professionals. Appropriate for ages 10 and up.

"Build your dream"



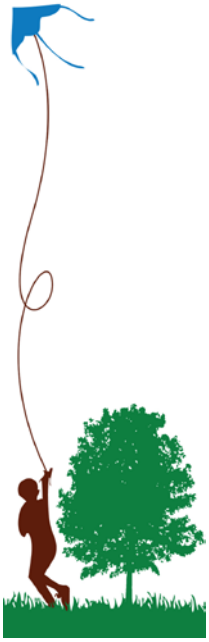
Preparation

Before the day of the activity

- ☐ Use the *Implementation Guide* to determine the setup of your engineering program(s), organize and prepare your presentation, and help you collect the materials.
- ☐ Prepare publicity materials for these or any other future engineering and technology events.
- ☐ Optional: Incorporate the *Playful Building* PowerPoint presentation into your facilitation plan. Modify the presentation to suit your needs.
- ☐ Collect and prepare the materials.

The day of the activity

- ☐ Set up the facility.
- ☐ Set out the materials.
- ☐ Print the *Brief Facilitation Outline* page, which integrates the steps of the activity with the annotated facilitation outline presented in the *Implementation Guide*, to use as presentation notes.
- ☐ Provide access to any supporting media and the *Playful Building* PowerPoint presentation (or printed copies of the instructions slides for this activity).
- ☐ Set out the *Grand Challenges* page and the *Be Creative* poster (or hang them on a nearby wall).



Activity

1. Optional: Use the supporting media to explore examples of engineers working in teams to take on a challenge

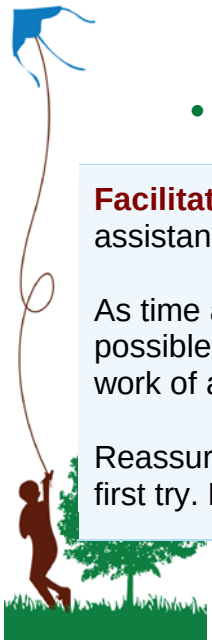
2. Challenge a group of 6–20 people to make a "human machine" that passes a beanbag to each person — the faster, the better! Direct them through the following steps:
   - Form a circle.
   - Establish a pattern: Say your name and then toss the beanbag to someone across from you (not next to you). Remember the name of the person who catches the beanbag.
     - For an added challenge, recite the names of those who have already passed the bean bag — in order!
     - After each person in the circle has caught the beanbag, the pattern is set. For the rest of the activity, pass the beanbag to the same person while you say his or her name.
   - Choose a timekeeper.

3. Challenge the groups to decrease the time required to pass the bean bag to each person by using the iterative engineering design process: creating a new method, testing it out, and making adjustments to improve their idea.
   - Think: How can you decrease your time?
   - Build and test: Work together to increase your speed! Pass the beanbag around the circle again — as quickly as possible!
     - Time each round.
     - Record your times on the common writing area at or near the activity area.
     - Keep the same order as in your first round, e.g., Sam passes the beanbag to Keisha, who passes it to Mia, etc.
     - Each person must catch the beanbag.
     - Each time you pass the beanbag, you must say the name of the person who will catch the beanbag.
     - You may move around.
     - You may stand or sit. Some people may need to use a chair.
   - Do it again!: Make adjustments to improve the design.

Facilitator's Note: Allow the participants to arrive at their own solution with as little assistance as possible.

As time allows, emphasize this stage of the engineering design process as much as possible. Adjusting and retesting their ideas is the best way to experience the ongoing work of an engineer! Over time, they will be rewarded by seeing improvement.

Reassure the participants that there isn't a "right" answer that they must arrive at on the first try. Furthermore, failure is an essential part of figuring out what works and what



doesn't. It is OK to fail — and try again . . . and again . . . and again!

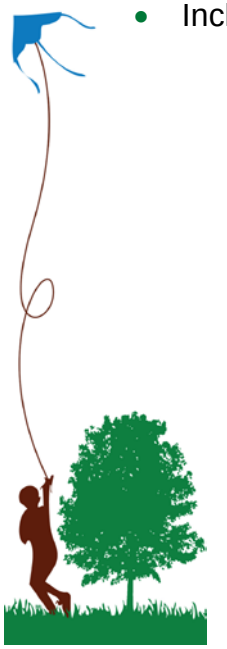
Emphasize how their engineering efforts are a social endeavor. If the groups worked together well, comment on the different contributions of leadership, keeping time, creativity, and willingness to try different ideas that led to their success.

On their own, many groups eventually create a ramp (inclined plane) or descending spiral (screw). The participants stand in order, in a tight circle, with one arm outstretched. The hands are arranged to form a descending spiral, and the bean bag is rolled down this "ramp" as each person chants his or her neighbor's name.

4. Optional, for those who create a ramp: Ask questions of the group to help the participants relate their "human machine" design to two simple machines that are common in community parks: inclined planes and screws. Draw out the following points:
    - An object can be lifted straight up — or it can be pushed diagonally up an inclined plane (like a ramp).
    - Inclined planes make it easier to move something up or down. It takes a stronger pull to lift something up directly than to pull (or push) it up a ramp. It takes the same amount of energy either way (ignoring friction). But it takes a smaller pull or push to move that object because you are pushing it over a longer distance compared to lifting it straight up.
    - A screw is a type of inclined plane that has been wrapped into a spiral shape.

Facilitator's Note: A screw is an inclined plane that has been wrapped around a cylinder. In the case of a spiral-shaped (or "twisty") slide at the park, the cylinder may be a pole, or it may be empty space. In the case of screws and bolts, an inclined plane is wrapped around a cylinder of metal. The threads of screws and bolts grip the materials like teeth — and may be holding the playground equipment and picnic tables together!

- Loads can also be moved quickly *down* an inclined plane or screw!
- Inclined planes and screws help us:
    - Move from place to place (wheelchair ramps, sidewalk ramps, stairs, and switchback roads or trails)
    - Have fun! (straight and spiral-shaped playground and water slides, skateboard ramps)

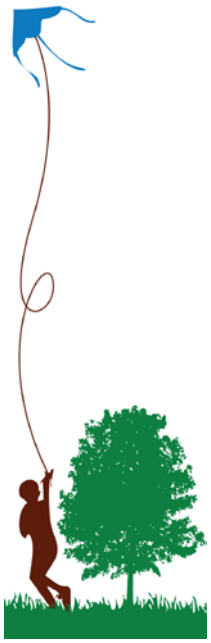


References

This activity was inspired by the following educational materials:

"An Introduction to Simple Machines," **Pre/Post Activities**, Copyright ©2008 Children's Museum of Houston.

Engineering: Simple Machines, Integrated Teaching and Learning Program, College of Engineering, University of Colorado at Boulder, © 2005 by Regents of the University of Colorado, www.teachengineering.org/view_lesson.php?url=collection/cub_/lessons/cub_simple/cub_simple_lesson01.xml.



Brief Facilitation Outline

Introduction

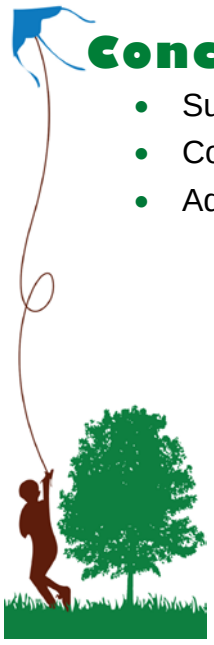
- Introduce yourself and the library.
- Frame the activity with the main message: Engineers work to solve the basic challenges of life — including having fun!
- Conversation:
  - Ask open-ended questions about things we need for *enjoyment* in life.
  - Discuss the role of teamwork and building on others' ideas in engineering.
  - Discuss examples of how engineers use (simple) technologies to improve lives, e.g., simple machines like inclined planes, screws, and levers are used for play.

Activity

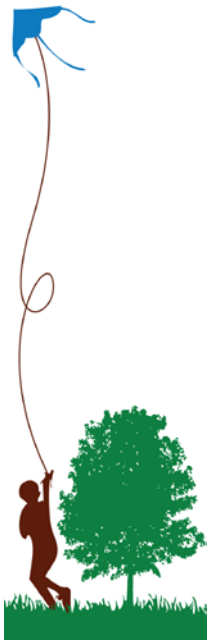
- Use supporting media to explore how engineers are working in teams (optional).
- Challenge (in a group of 6–20): Make a "human machine" that passes a beanbag to each person — quickly!
  - Begin in a circle and establish a pattern as each person tosses the beanbag and says the recipient's name.
  - Choose a timekeeper.
  - Use the iterative engineering design process (create a new method, test it, and make adjustments) to decrease the group's time while keeping the same pattern.
- Encourage persistence: Successful engineering involves a process of thinking, building, testing . . . and doing it again!
- Conversation (optional, for those who create a ramp): Relate the "human machine" design to inclined planes and screws — what they are, how they make it easier to move something up or down, and some real-life examples.

Conclusion

- Summarize the groups' explorations of how engineers solve life's challenges.
- Congratulate the groups on their accomplishments.
- Advertise any future engineering and technology events.



Activity Materials to Print



Be Creative...Be an Engineer!

Think, build, test, do it again: That's the process engineers use when they tackle a problem. Engineers don't have official rules telling them to follow this set of steps. But, over time they've learned that they get the best results this way:

They think and brainstorm about a problem and factors they have to consider to solve it. They come up with an idea and build a prototype. They test the prototype. And, then they repeat the process to improve their results.

Engineers often move back and forth within the loop, repeating two steps over and over again before moving forward. It's a key to engineering success.