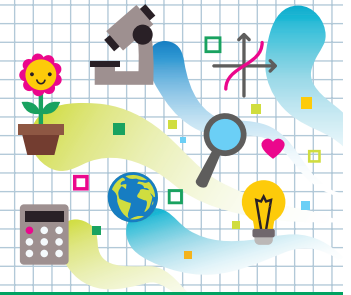




# HEADS IN, HEARTS IN

## Hello! Who Is Calling?

### Instructions for Set-Up



### Supplies

- “Guide for Families” handout
- Clear plastic standup display (optional)
- “Engineering Process” handout (1 per participant or family)
- Paper
- Pencils
- Cups of varying sizes and materials
- String, yarn or twine
- Scissors
- Metal paper clips
- Display table

### Activity Preparation

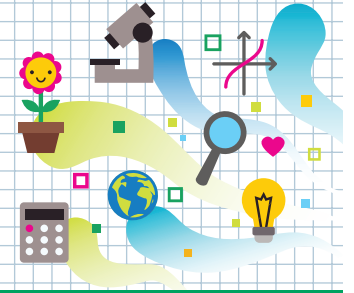
- ▶ Purchase or locate items on supply list.
- ▶ Print one copy of the “Guide for Families” handout. Laminate or place in a clear plastic standup display to allow participants to see it more readily.
- ▶ Print one “Engineering Process” handout per participant or family. Optionally, print and laminate a few to leave on the table.
- ▶ Using the scissors, carefully poke holes in the bottom of each cup.
- ▶ Using the scissors, pre-cut the yarn, string or twine into lengths of approximately 4 feet long.
- ▶ Set up the display table and arrange needed supplies.



# HEADS IN, HEARTS IN

## Hello! Who Is Calling?

### Guide for Families



### Learning Objectives

#### What you need to know:

Engineering is a process used to solve problems by designing, building and testing things. An engineer is a person who uses math and science to create new things, solve problems or make things better.

In this activity, you'll explore the transmission of **sound waves**, which are simply vibrations that can travel through any material. Your voice will vibrate the air inside a cup and those vibrations will go through the bottom of the cup and be transferred to the string, yarn or twine to the cup on the other end.

#### What you will do and learn:

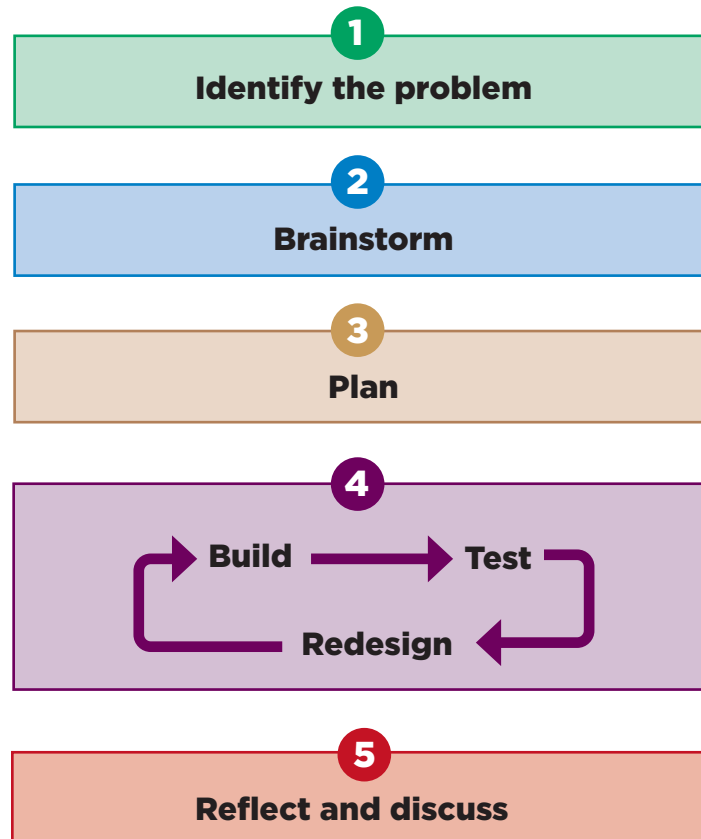
In this activity, you will practice using the engineering process to build a model of a telephone. Engineers often try a variety of building materials to see what works best and you will too. The goal of this activity is to build a model of a telephone to see which materials allow sound waves to travel best.

### Instructions

1. Using the "Engineering Process" handout, start to work through building your telephone.
2. Identify the problem: Using cups and string, yarn or twine, design and build a telephone that will allow you to communicate with another person from across the room.
3. Brainstorm: What are your options for your telephone "wire"? What material will transfer sound the best between two cups? Does the length of the string, yarn or twine matter? Does the type of cup matter? Does the size of the cup matter? How will you connect your wire to your cup? How can I build my telephone so that the person on the other end hears me well?
4. Plan: Make a drawing or sketch of your design. Based on your brainstorming, how will you design your phone with the materials you are given? Gather your materials.
5. Build: Build your telephone, using your design.
6. Test:
  - Find a partner. Each of you will take a cup and slowly walk away from each other until the string, yarn or twine is straight and tight, but won't break.
  - One partner will place the cup over their ear while the other partner will talk into their cup. Reverse roles.
  - Can you hear each other talking? What happens when there is slack in the string and it's not held tight? What happens if something is touching the string such as a finger, hand or wall?
7. Redesign: Make some changes to your design to improve the ability for sound waves to travel and your partner to hear. Try some of the ideas you came up with during your brainstorming.
8. Repeat steps 5 and 6 as many times as needed.
9. Reflect and Discuss: What type of string, yarn or twine allowed you to hear the best? Do you think the size of the cup was important? Did it matter if it is a paper cup or a plastic cup? Did the length of string, yarn or twine matter? What materials could you use instead of the materials provided today? How would it have been different with different materials? How might this apply to the real world?

# Engineering Process Handout

## Engineering Process



- 1. Identify the problem:** Engineering is about identifying problems and designing solutions. As you go through these activities, think of the goal you are trying to achieve.
- 2. Brainstorm:** What are the many different ways I could solve this problem? What are the potential advantages and disadvantages of different ideas? What things do I need to think about to make that solution successful?
- 3. Plan:** What are the different ways I can solve this problem or make the build? What steps can I take to try out my solution? What do I need to do to prepare my build? What might happen if I choose that solution? During your design phase, you might discover new problems that you need to brainstorm.
- 4. Build:** Construct and carry out the design. As you build your design, you might come up with more problems that you need to brainstorm and design new ideas for.  
**Test:** How does my solution work? Does it solve the problem? Is it effective? Are there additional problems?  
**Redesign:** How can I improve my design? What can I try to make my solution work better?
- 5. Reflect and Discuss:** How did the solution turn out? What could I do differently next time? How would my design be different if I had different materials?