

STRING TELEPHONES

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DESIGN IT! ENGINEERING IN AFTER SCHOOL PROGRAMS

Education Development Center, Inc.

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Activity 1: Making a String Telephone

Did you know that you can set up a telephone system at your home or in your school that lets you talk to friends without paying for the call? A string telephone is cheap to make and easy to use. All you need is string, paper clips, and paper cups.

What Materials Do I Have?

- 2 paper cups
- string or twine (20–30 feet)
- 2 paper clips
- 1 sharp pencil or nail
- message cards
- *Data Sheet—Activity 1*

THE CHALLENGE

Make a telephone and send a message to a partner. Think of ways to make the telephone work better.

What Do I Do?

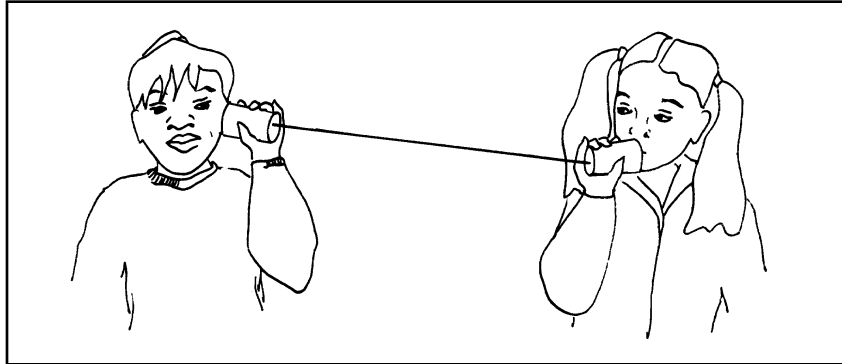
1. Make a small hole in the base of two paper cups with a nail or pencil.
2. Push one end of the string through each hole.
3. Attach the string to both cups. [Hint: Use the paper clip.]
4. Try sending messages through your new telephone.
5. Get a message card from your teacher. One partner should send the message and the other partner (at the other end of the phone line) should write down what he or she hears.
6. Figure out how to make the messages as clear and loud as possible.

What to Think About

On *Data Sheet—Activity 1*, write down some tips you could pass on to someone else about what does and does not work when building and using string telephones.

Data Sheet—Activity 1

Team Members: _____, _____



What Works?

What Doesn't?

Activity 1: Making a String Telephone

PREPARING AHEAD

Make one copy of *Data Sheet—Activity 1* for each team and make enough copies of the *Letter to Families* (found on page 59 in the Appendix) for each child to bring home.

Make a telephone with a piece of string (about 20–30 feet long) and two paper cups. Find someone to help you test it and notice the best way to make it work well (how you're holding the cups, how tightly you pull the string, etc.). You should notice, for instance, that it doesn't work particularly well unless the string is pulled very tight. You may also notice that the string keeps pulling out of the holes in the cups. To stop this, it helps to thread a paper clip through the knot in each end of the string. This allows you to pull the cups firmly apart without pulling the string through the hole in either cup.

Make up about a dozen message cards (one message per card) using index cards (3 x 5 inches). The messages should be short and easy to read, written in bold clear letters, and numbered for easy reference. Create messages that you think will be interesting to the children and easy to read at their reading level. See the Appendix (page 57) for a list of possible messages. You will give these to the children to send across their phones when they are ready. Here are some suggested messages:

- One large cheeseburger to go, please.
- I have a cat named Fiddlehead.
- When I am older I want to live on Mars.
- My dog digs holes in the yard.

INTRODUCING THE ACTIVITY

Do not skip over the Introducing the Activity section in any *Design It!* project! Experience shows that much can be gained from spending a few minutes thinking (and talking) about a design project before diving into the materials. Here are the things you should try to do before handing out the materials:

- **Set the stage.** Tell the children, very briefly, what they will be doing during this project and how long they will be doing it. In this case, the goal is to make different types of telephones and telephone networks that use homemade materials.
- **Offer a motivation for the project.** Explain what they will learn about during the project. In this case, they will learn a great deal about how sound (and other signals) can travel through strings and wires.

Materials

FOR EACH TEAM

- 2 paper cups
- 20–30 feet of string*
- 2 paper clips
- 1 sharp pencil or nail
- *Data Sheet—Activity 1*

FOR THE WHOLE GROUP

- index cards
(3 x 5 inches)

*Have plenty of extra string on hand in case the children tangle or break their first pieces.

If you have enough space, let the children use longer pieces of string throughout this project. The farther away the speaker and listener are from each other, the more likely it is that the listener is actually hearing the speaker *through the phone* and not just through the air.

- **Assign roles.** Explain each role carefully and make sure everyone understands his or her job.
- **Find out what they already know** about the topic. This helps children feel knowledgeable and tells you what they actually do (or do not) know.
- **Show the materials** and explain any limits on their proper use.
- **Describe the challenge.** In this case, the challenge is to make a simple string telephone and send messages across it.

So before you hand out the materials for this activity, show the children the string telephone you made and ask two volunteers to demonstrate it for you. Let them talk to each other for a few moments and ask them whether they can hear and understand each other. Thank these two volunteers and send them back to the group. Then ask the whole group:



Does anyone know how to make this kind of telephone work?

Some of the answers offered will be about vibrations and waves going down strings and so on. These are natural answers to the question, but don't focus on them yet. Vibrations are described in more detail in Activity 2, but for now, stay with the most visible and practical details. The question is not, "How does IT work?" The more practical engineering question is: "How do WE make it work?" (What do you have to do to it to make it work?)

So, steer the conversation towards the things they can do to make the phone work best. Put up a blank chart like the one on *Data Sheet—Activity 1*, and title it *What Works?* Ask the children to brainstorm what they think is important about the design of this kind of telephone. Write whatever they say on the chart even if you think it isn't right. Later, after they have actually made telephones, they will return to this list to see how accurate their first ideas were.

THE CHALLENGE

Make a telephone and send a message to a partner. Think of ways to make the telephone work better.

LEADING THE ACTIVITY

After you have introduced the project and stated the challenge, divide the children into teams of two and hand out the materials. Younger children may have trouble tying knots in the string. Try to anticipate this problem when you divide the children into teams. Perhaps you could pair an older child with a younger child where necessary.

Troubleshooting

If children are having problems assembling their phones, you can ask:



- What works (and what doesn't)?
- What did you try (and what happened)?
- What has worked for other teams?

Try asking these questions as you walk among the children, and pay careful attention to their answers. Asking these questions and holding the children's attention long enough for them to think of an answer will often help them over design roadblocks. Table 1.1 shows some obstacles children often encounter when making string telephones. Next to each problem are hints on how you can help the children solve the problems for themselves, beyond asking the questions listed above.

Table 1.1

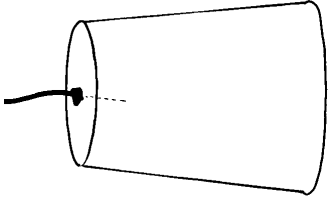
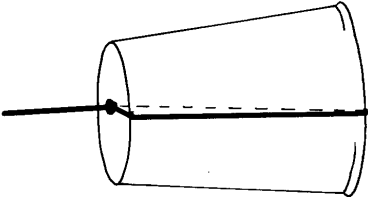
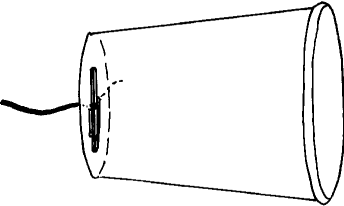
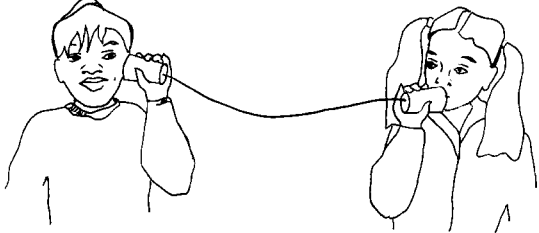
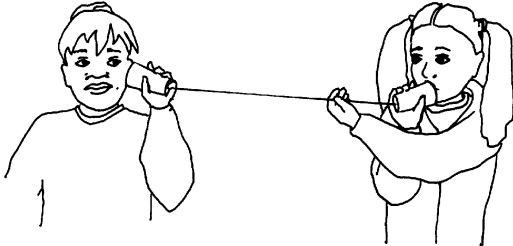
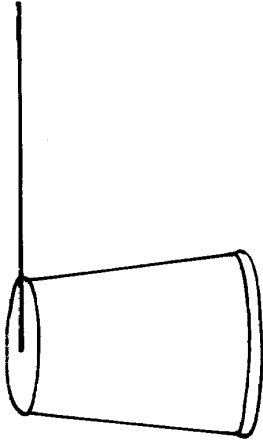
Problem	Action to Take	Image
Knot tied on wrong side of cup base	None. The string will fall out of the cup and the children will discover their mistake soon enough and correct it on their own.	
String tied around outside of cup	None. This method is not "wrong," but it does not make for a very good telephone. It is a good way to stop the string from pulling away from the cup, but it tends not to transmit the sound as well as the arrangement with the knot in the center of the base.	
Hole in cup is too big	Tie a paper clip to the string on the inside of the cup. This will allow you to pull the string tight without it pulling through the cup.	

Table 1.1 (cont'd)

Problem	Action to Take	Image
String not pulled tight when “using” phone		
Hand or arm touching string	<p>Do not suggest anything at first. Let the children experiment with the phones to see what works for them. They should notice on their own that the phone works best when the string is tight, in line, and free of contact with any other object.</p>	
Cup perpendicular to string	<p>If they don't figure out the characteristics of the string that make their phones work best, mention the three characteristics noted above to see if the children agree with you that they make the phone work better.</p>	

LEADING THE DISCUSSION

After the children have had ample time to play with their telephones (allow them more time if they are very engaged and less if they are losing focus), ask them to put their telephones and other materials down and come together in a Discussion Circle. Then spend a few minutes (not more than 10) discussing what works and what does not, in respect to both construction and use of the telephones.

As you talk with the children, either start a new *What Works?* chart or add their ideas to the existing chart. Table 1.2 lists some of the answers you might hear. For now, put all of the children's comments on the chart, even if one answer is contradictory to another or if you do not think it is accurate. You will return to this list later with the children to refine their observations about what does and does not work.

Table 1.2

WHAT WORKS	WHAT DOESN'T
<ul style="list-style-type: none"> • The string must be tight (straight). • The paper clips stop the string from pulling out of the hole in the cup. • You have to put the cup over your ear to hear the message. • You have to talk right into the cup. • It's easier to hear if you block your other ear. • You must have enough room to spread out. 	<ul style="list-style-type: none"> • The string is crooked or loose. • No paper clips are used. • Both people are talking at once. • Something is touching the string. • The string is touching a wall or door frame. • There's too much noise in the room. • You can't cover your mouth with the cup when you speak.

After the children have said everything they know about the telephones, send them back to work on them some more. If you have assigned roles to each team, remind the ambassadors that it is their job to carry the information gained in this sharing session back to their partners and to discuss trying things with their partners that obviously worked well for another team.

As the children play with their phones, hand out message cards like those described on page 13. Have them use the messages on the cards, and tell children that the listeners must write down what they hear each time the talkers send a message. If the listeners are not sure exactly what they hear, they should make their best guess.

Before the end of the first session, call the children into a Discussion Circle one more time. (Remember to have them leave their phones away from the Discussion Circle). See if, together, you can refine the *What Works?* chart. Go through the list you made earlier and ask the group if they still agree with each item. Perhaps the group will agree to eliminate certain items that they first thought to be true. Out of this process, see if you can come up with a short list of "findings" (or conclusions) about making string telephones work best.



Ask the children, "What list of findings have we found out that would help someone else make a working string telephone?"

Go back to the *What Works?* chart and have the children try to agree on certain statements that are always true for these materials. Write these findings on a new chart titled *What We Know About String Telephones*. Findings that the children may suggest include:

Guiding the Activity

- You have to pull the string tight.
- The string has to be straight.
- You have to hold the cup to your ear.
- The cups and string should be held so they are all in line.
- You shouldn't hold the string with your hand while you are talking.
- The string shouldn't touch anything else while you are talking (including the edge of the cup).
- The string has to be in the middle of the cup.
- It works best if you don't cover your mouth with the cup when you speak.

It is unlikely that the children will notice all of these factors the first time around. In addition, they may have ideas that you think are false. You should *make no judgment* about whether the suggested ideas are right or wrong. Later you will come back to this chart and test each item to see if it holds up.

Activity 1: Making a String Telephone

RATIONALE

A string telephone is a simple yet very engaging device for children of all ages. Even children who may have seemed disinterested at the beginning of the project will get quite excited at the fact that they can hear each other through the phone. This activity begins with the simplest version of the device—two paper cups, a piece of cotton string, and a couple of paper clips. By giving the children no choice about the materials, you make sure that their attention is on the basic design of the device. Otherwise they might get caught up with too many factors or variables (different cups, types of string, etc.). Later there will be a chance for them to try other materials to see if they can improve the quality of the sound in their phones.

INTRODUCING THE ACTIVITY

You might want to spend a few minutes establishing with the children what it means to be an engineer, and how that word relates to the work they will do in all *Design It!* projects. Begin by writing the word “engineer” on the board or chart paper and asking them what they think an engineer does. Use the brainstorming technique described on page 31 of *The Implementation Guide to Design It! Projects* to draw out their ideas. Write all their ideas on the chart. They may say things like, “An engineer drives a train/airplane,” “An engineer fixes/makes things,” and perhaps even, “An engineer makes the toaster work right.”

When all the ideas are out, thank and congratulate the children for the variety of their ideas, and then circle all the definitions on the list that are more or less the same as, “An engineer makes/fixes/designs things.”

Tell the children that in this project they will all be engineers and that they are going to learn how to make some fun things, beginning with a homemade telephone system.

LEADING THE ACTIVITY

Making string telephones is a pretty straightforward task for most children in grades 2–5. Children may have different approaches to making phones, some of which will work better than others, but few children will be altogether confused, especially since you have already shown them a working phone.

Your main task as they work is to keep them focused on the challenge and help them overcome minor roadblocks that might get in the way of the best possible design and use of their phones. The chart of common problems

(Table 1.1) is intended to alert you to the kinds of things that often come up. It is by no means a complete list, so you will have to be creative in dealing with new situations that were not anticipated. The general rule in all *Design It!* projects is that you never tell the children what to do or how to solve a problem until you have given them the chance to engage their own problem-solving skills. Hence the questions:

- What works (and what doesn't)?
- What did you try (and what happened)?
- What has worked for other teams?

If the above questions don't help, you can start to give hints in the form of "What if?" questions.

- What if you try pulling the string tighter?
- What if you don't speak so close to the cup?
- What if you make sure there is nothing touching the string?

LEADING THE DISCUSSION

Discussions about design projects should be separate from the actual handling of the materials. Children are usually not keen to switch from touching to talking, so it is important to make the transition very obvious. It is suggested that all materials be placed on a table or other safe place and that the children gather in a Discussion Circle **away from the materials** to avoid distractions while they are talking.

Discussions should be short at first. In the early stages, discussions are more about setting up habits and routines than about "getting to the truth." Eventually both can happen, but it probably will not happen immediately. Therefore, try to observe the following guidelines from the beginning:

- Keep the early discussions short (5–10 minutes).
- Insist that only one person talk at a time.
- Insist that everyone take a turn. Work out your own way to keep it fair, but make the system clear and consistent (hand raising, etc.).
- Keep it "safe." Don't tolerate any meanness or put-downs between the children.
- Reflect. Repeat back to the speakers the essence of what they said so they will know that they were heard and whether they were understood.
- If possible, have more than one discussion each day. After talking for a few minutes, send the children back to work and then break for a second, longer discussion.

Listing the "findings"

When the solution to a problem is so clear that most of the children agree on it, it is called a "finding." List these findings on a separate chart with the title *What We Know About String Telephones*. In *Design It!* projects, children are not given a "how-to" manual; it is important that they figure out the solutions for themselves. The last part of the discussion, therefore, is an

attempt to get the children to agree on a small number of general findings that would apply to the making of a string telephone by anyone, anywhere, using almost any materials.

It is important that you (as the teacher) do not say whether a proposed finding is right or wrong. For every one of the ideas suggested on page 18, the children are perfectly well equipped to figure out for themselves whether or not it applies. If they think the string has to be tight, then try using the phone with the string tight and loose. They can easily tell which one works better.

You can, however, insist that if they propose a finding, they be clear about whether they have already tested it, or how they would do so if they have not. So if someone says that the hole must be in the middle of the cup, you can ask, "How do you know that? Have you tested it? How could you test it?"