This guide is intended for teachers interested in starting the communications activity in Telepong Part 2 as quickly as possible.

Refer to Telepong Part 1 and Telepong Part 2 for complete activity instructions.

**NGS Standards**

**Performance Expectations**
MS-PS4-1, *-ETS1

**Science and Engineering Practices**
- Planning and Carrying Out Investigations
- Constructing Explanations and Designing Solution

**Cross-Cutting Concepts**
- Patterns
- Cause and Effect: Mechanism and Prediction
- Structure and Function

**Disciplinary Core Ideas**
- Information Technologies and Instrumentation
- Defining and Delimiting Engineering Problems
- Developing Possible Solutions
- Optimizing the Design Solution

**Materials**
- 12-16" tubes (Paper towel tubes work just fine, but clear tubes are best. Many packing-products vendors sell 1.5" diameter plastic mailing tubes).
- Clean cardboard boxes
- Plastic containers, washed and dried
- Packing materials
- Card stock
- Other craft supplies: pipe cleaners, floral wire, paint stirrers, etc.
- Ruler
- Masking tape or hot-melt glue gun
- Scissors, hobby knife, or box cutter
- Durable cutting surface

**Grades:**
5+

**Duration:**
25-45 minutes

**Prep Time:**
20 minutes

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1 Adult supervision required for all activities which involve cutting or using hot glue. Use appropriate cutting implements on proper cutting surfaces.
**TRIED-AND-TRUE RECEIVER CONSTRUCTION:**

1. Cut a base out of cardboard; a ~6” square or circle is easiest. Does not need to be precise.

2. Take plastic cup and tube. Position tube outside on bottom of cup. Trace a hole around the **outside of the tube** you are using.

   ![16 oz. plastic cup or similar](image)

   - 1 5/8” diameter hole in bottom
   - Trace/mark with tube before cutting

3. On bottom of cup, cut slightly **inside** your traced lines for best fit. Widen gradually until the tube fits snugly into the hole.

4. Cut a fingernail-shaped lip out of the rim of the tube. The sides of the fingernail should be diametrically opposed, curving together to meet 1.5” from the original end of the tube. **Cutting the lip into a rounded ‘scoop’ shape at the bottom is important.**

   ![11”](image)

   - 0.75” or halfway

5. Mark 0.5” **below the bottom of the new scoop lip.** This will help us **initially** position the bottom of the cup in the next steps.

Optional: If using cardboard, use a blade to cut a viewing window in the front of your tube. Recommended dimensions are a 0.75” by 7” slot, positioned 0.75” from one end of the tube. This will help learners quickly read (“decode”) the stored message as it comes in.
6. Tape or hot glue the tube in the center of the base, with the scoop-lip end pointing up.

7. While holding the cup in place, adjust the height & angle of cup until ping-pong balls which enter the cup reliably fall into the tube. Don’t attach it permanently yet; make sure you’re able to fine-tune the position.

8. Test a few times with ping-pong balls until they tumble smoothly and reliably from the cup into the tube. Once you are satisfied with the fit, then hot glue or tape the cup to the tube.

CONGRATULATIONS!
You have made a simple communications ground station. Now you’re ready to start receiving data from space; see our other activities to continue exploring the communications and engineering design processes.

For a more reusable option, contact gsfc-scan-engagement@gsfc.nasa.gov for instructions on constructing sturdier, more travel-friendly receivers which can accommodate multiple groups of learners. These receivers require more hardware, assembly, and access to a 3D printer.

Suggestion: If you’re having trouble getting the balls to flow into the tube, consider widening the scoop lip.

FOR MORE SCAN ACTIVITIES, VISIT:
- Exploration and Space Communications Activities
- NASA Kahoot! Quizzes

A digital copy of this activity, including hyperlinks, can be found at https://go.nasa.gov/telepong03