

Range Limitations of Wireless Technology

Purpose: The objective of this activity is for the students to explore some of the factors that limit the range of wireless technology

Overview: Wireless technology depends on waves traveling through a medium to transfer a message or some other intelligence from one point to another. Just like it is difficult to carry on a conversation across a crowded, noisy room because of all the extraneous noise (interference) and the distances involved, waves in wireless technology also suffer from the same problems when there is interference in the medium.

In this activity students will determine how the range of a garage door opener and a TV remote control are affected by various conditions in the medium. From the students' observations they will make the connection between various factors that degrade the transmission medium and how that affects the wireless device.

Time: One class period to discuss interference and other factors that limit the range of a wireless device. One class period for students to report their observations. If the activity is done in class, one class period will be required to do the activity and collect the data.

Skills Required:

- Listening
- Observation
- Critical Thinking
- Writing and expression

Materials and Tools:

- Home garage door opening system and/or TV/DVD remote control
- Long measuring tape

Preparation:

1. Review with the students the concept of wave propagation and some of the factors that affect the ability of a wave to propagate (interference, obstructions, line-of-sight, signal strength, etc.).
2. Review with the students the type of wireless technology that is used in a garage door opener and the factors that affect the ability of the wave to propagate between the controller and the garage door opener (proximity, low power, low battery power, structure walls, garage door, etc.).
3. Review with the students the type of wireless technology that is used in a TV/DVD remote and the factors that affect the ability of the wave to propagate between the remote and the TV/DVD (proximity, line of sight, wall surface texture, ambient light, angle between remote and receiver, etc.).

Background:

Now You're Talking pages 6.14-6.17.

What to do and how to do it:

1. Assign students, with a partner, to determine the range of their home garage door opener with the garage door open and with the garage door closed. One student will activate the remote garage door opener; the other student will use the electrical switch that controls the door within the garage.
 - a. Starting with the garage door closed and starting from the normal location where the garage door remote is usually activated, move away in approximately 10-foot increments and attempt to open the garage door. Between each successful opening of the garage door, the student partner inside the garage at the manual switch will close the door. Find the location where the garage door will no longer open with the remote controller. Measure that distance and record in the journal.
 - b. Now starting with the garage door open, determine the maximum distance that the garage door can be closed with the remote. The student with the remote moves away in approximately 10-foot increments and attempts to close the garage door. After each successful closure, the student inside the garage will open the door for the next attempt. Find the location where the garage door no longer closes with the remote controller. Measure that distance and record in the journal.

2. The activity with the TV/DVD remote should be accomplished at various times of the day or night. The object is to determine the maximum distance that the remote control can be used to control the TV/DVD under different conditions.
 - a. Under normal daylight conditions, move away from the TV/DVD in small increments and see at what distance from the TV/DVD that you can no longer control the device. Record the light conditions and the distance in your journal.
 - b. Now close all the curtains in the room to make it as dark as possible and repeat the activity. Record the light conditions and the distance in your journal.
 - c. Under nighttime conditions, repeat a. above and record your observations.
 - d. Now turn on normal room lighting and repeat the activity. Record the light conditions and the distance in your journal.
 - e. Shine a bright spotlight or flash light on the TV/DVD in the area of the appliance where the wireless receiver is located (usually a plastic covered window in the bottom front of the appliance, near the manual controls). Repeat the activity and record the light conditions and the distance in your journal.

- f. If you have a second remote control that is used on another device, try to control the TV/DVD while simultaneously shining the other remote control and determine if there is any effect on the performance of the actual remote.

Data Analysis:

1. Assign students to create a data table that lists the type of wireless device, the conditions of the activity, and the maximum distance of operation.
2. Assign the students to infer from the collected data what conditions affect the operation of the wireless device.

Activity questions:

1. Was there a difference in the range the garage door opener would work between the door being open and the door being closed? Why?
2. Would it have made a difference if you had done the activity while in a car? Why or why not?
3. Are there any other ways you could have done this activity to do more tests and checks? What are they?
4. What could you do to improve the range of your garage door opener? Is it advisable to improve the range? What do you think is the reason that the range of a garage door opener is limited? Why does your garage door opener work on your garage door but not your neighbors' door?
5. Did the lighting conditions in the room affect the range of your TV/DVD remote control? If so, how?
6. How might the texture of the wall surfaces in the room affect the TV/DVD remote?
7. Do the activity again but point the remote into a hand mirror position so that the signal would be reflected back toward the TV/DVD (you can determine this position is correct if you can see the TV/DVD in the mirror). Did the remote control the TV? Why?

Adaptations for special needs: There should be no accommodations required for this activity.