**ACTIVITY: Investigating satellite dishes**

**Activity idea**

In this activity, students use a model of a satellite dish to investigate how a curved reflector can be used to increase Wi-Fi signal strength as received by a cell phone.

By the end of this activity, students should be able to:

* describe how a concave satellite dish receives signals from a satellite
* use a model of a satellite dish using an umbrella and aluminium foil as a curved reflector to increase the strength of a Wi-Fi signal and to locate the position of maximum signal strength.

[Introduction/background notes](#Introduction)

[What you need](#need)

[What to do](#Do)

[Extension ideas](#extension)

**Introduction/background**

A satellite dish is a concave reflector. For TV reception, it reflects the signals sent from a satellite nearly 38 000 km away and focuses it onto the receiver. This very weak signal is then amplified and sent to a television decoder.

A signal from a satellite is similar to a cell phone or Wi-Fi signal. To receive a strong signal, the satellite dish needs to be accurately aimed towards the satellite. The satellite dish also needs to be large enough so that a strong enough signal can be directed onto the receiver.

In this activity, students use an umbrella lined with aluminium foil as a model satellite dish. They use this model to increase strength of a Wi-Fi signal as received on a cell phone.

For more information, see the article [Satellite communications](https://www.sciencelearn.org.nz/resources/270-satellite-communications).

**What you need**

* Umbrella
* Aluminium foil
* Tape
* Cell phone with ability to connect to Wi-Fi
* Wireless modem/router
* Internet access

**What to do**



1. Before the session, open an umbrella and line the inside with aluminium foil. Neatly tape each segment in place.
2. Turn on the wireless modem and the cell phone. Ensure that the signal strength received by the phone is strong. Carry the phone in a straight line away from the wireless modem until the strength of the signal decreases to only one bar.
3. At this location, aim the handle of the open umbrella towards the wireless modem and place the cell phone about half way along the handle of the umbrella. A stronger signal should be observed. Find the optimum location of the cell phone for greatest signal strength. This is the focal point.



1. Angle the umbrella handle slightly downwards at an angle of about 30°. Find the new position where the signal strength is strongest.
2. Try to see if a weak cell phone signal can be improved using your reflector pointed in a certain direction. Investigate to see if Bluetooth connectivity can be similarly improved.
3. Discuss why the cell phone was positioned in that way. (The receiver of a satellite dish is placed at the focal point. In most home satellite dishes, the dish is directed slightly downwards of where the satellite is. The location of the focal point is lowered so that the receiver is placed out of direct line of signals coming towards the dish and less interference is produced.)
4. Discuss what students already know about satellite television broadcasting:
* How many satellites are needed to cover all of New Zealand?
* How high is/are the satellite(s)? Where?
* How is the signal broadcast?
* How does a satellite dish receive a signal?

You may like to get students to write about what they know and to include any diagrams or questions they have.

1. View the video clip [Communicating with satellites](https://www.sciencelearn.org.nz/videos/124-communicating-with-satellites). Discuss TV transmission by satellite.
* A main advantage of satellites for TV is that only one satellite transmitter is needed to cover a whole country. A geostationary satellite orbits at an altitude of approximately 36 000 km, which is approximately three times the diameter of the Earth. If you use a ball as a model of the Earth, a TV satellite is above the equator. For New Zealand, this satellite is at a longitude of 160°, so a television signal needs to travel approximately 38 000 km from the satellite to a house. This is only slightly less than the distance once around the whole Earth.
* Discuss how a satellite signal is similar to a Wi-Fi computer signal at home but that the beam is focused towards the country. The data signal spreads in a similar way to light from a torch spreading. At a great distance, the signal strength is very weak so needs to be made stronger using a satellite dish.
* The radio signals used for this type of television signal are a type of electromagnetic radiation. To learn more about reflection in mirrors, see [Reflection of light](https://www.sciencelearn.org.nz/resources/48-reflection-of-light).

**Extension ideas**

* Use [www.dishpointer.com](http://www.dishpointer.com) to find the correct direction that a satellite dish for Optus D1 should be pointed for your location. (You may also like to download a dishpointer phone app.) The azimuth angle is the angle as measured from true north. For example, an azimuth (true) of 336° means that the dish needs to be pointed towards the west by 24° (this is 360° minus 336°). Note that magnetic bearings are also available. You may also like to download a compass app. Notice that all satellite dishes in a town are pointed the same way. **Note:** **Do not try to alter the direction of your satellite dish**. A 2° error can mean the difference between excellent and zero satellite reception.
* Use [www.satbeams.com/footprints](http://www.satbeams.com/footprints) to view the footprint coverage area of a satellite such as the Optus D1. Notice how there are certain areas where the signal strength is stronger than other areas. Find out about other satellites that may be accessible.
* Research to find out why early satellite dishes were so large compared with modern satellite dishes.