Infrared Camera
Use a FLIR camera with iPad or phone to show students how they emit infrared light. (It's currently in the lab so I'll have to dig it out… but it's very straightforward.) Some simple ways of playing with the infrared camera can be found at:
https://www.flir.com/globalassets/discover/instruments/education/student.pdf

Demo using pasta strainer and radio based off of:
https://www.haystack.mit.edu/edu/pcr/amradio/radio1.htm

Purpose: Demonstrate that radio waves are NOT the same as sound, and that radio waves can be blocked (or reflected) by metal.

Materials:

- Tinfoil
- Portable radio
- Pasta strainer
- Phone or other device that can play sound that is already downloaded

Start off by asking what students know about radios, radio stations, and radio waves. You're particularly looking to get their ideas regarding whether radio is sound or light.

Show or pass around the pasta strainer. Ask if light can go through it? (Mostly, yes, visible light can mostly go through it.) Ask if sounds can go through it? (Yes, and you can demonstrate by putting it on your face and making funny noises because that usually gets a laugh.

Now introduce the AM/FM radio. Set the radio to a clear FM station. Have the students identify that sounds is coming out of the radio. But how does the radio know what to play? They'll likely have heard of a radio station before, and know that it is broadcasting from a location. The radio picks up that signal and turns it into sound.

Place the radio on a sheet of tinfoil, and ask what will happen when the strainer is put on top. Then, demonstrate. The radio will cut out to static. Ask the students why?

Here you can demonstrate that, again, sound does penetrate the strainer, by playing a downloaded sound file from a phone or other device. (Remember, it's important that it is downloaded and NOT streaming.) Explain that the information creating the sound is already in the device/phone, and that the sound can easily escape.

Go back to the radio under the strainer. So they know that the sound isn't being blocked, so what is? It's the signal coming from the radio station telling the handheld radio what sounds to make. That is a type of light. But, obviously, it's not quite visible light, since that goes through the mesh. It is light that gets blocked by that metal mesh. It is radio waves.

Here you can begin to talk about radio waves as a type of light that is invisible to our eyes, but otherwise very similar to “normal” light. You can introduce the concept of wavelength and say that the larger radio wavelengths are blocked by the mesh even though the smaller visible wavelengths go through it.

Itty Bitty Radio Telescope
Loosely based on http://www.aoc.nrao.edu/epo/teachers/ittybitty/

Radio telescopes come in many different shapes and sizes. For a quick photo tour of some radio telescopes and what they see, you can use:
https://www.cv.nrao.edu/~sransom/web/Ch8.html

What they are going to build this semester is a radio telescope that is useful for studying radio waves from Jupiter. (This might be a good image for showing the final product - http://hamsci.org/sites/default/files/article/20170216_radiojove/Radio%20Jove%20HamSCI%20Fig3.png)

They are going to start with the easiest, cheapest radio telescope out there, the Itty Bitty Radio Telescope. This is essentially an 18-inch (or so) satellite TV dish that has been repurposed for some really basic astronomy. Basically…. It can see the Sun.

Why does it work? Everything that has a temperature gives off electromagnetic radiation (which you can tie back to the FLIR demo). We even give off radio waves! The radio telescope doesn’t see the atmosphere, so the blank sky is basically zero (or close to it). The Sun on the other hand, it very hot, at almost 10,000 degrees Fahrenheit. So, it gives off radio waves.

Demonstrate with the IBRT, explaining that like the AM/FM radio, the signal meter is turning the radio light collected by the dish and converting it to sound. High pitch is bright, low pitch is dark.

(For your information, changing the gain will change the pitch as well. This makes the telescope more or less sensitive. It should be set around the middle.)

But, people give off radio waves, too. Not as brightly as the Sun, but you can demonstrate how people, trees, building, etc. show up on the telescope by making the noise high-pitched.

What other things give off radio waves? Cell phones, wifi hot spots, bluetooth devices, fluorescent lights…. There’s no end to what your IBRT will see, so explore with them!

More helpful tips on using the IBRT with pictures:
http://www.gb.nrao.edu/epo/ambassadors/ibtmanualshort.pdf

Public resources on radio astronomy:

- Step through the National Radio Astronomy Observatory's pages on the basics, with no math, at https://public.nrao.edu/radio-astronomy/what-is-radio-astronomy/
- The Smithsonian has a short primer on Jupiter's radio emissions - https://airandspace.si.edu/exhibitions/exploring-the-planets/online/solar-system/jupiter/environment.cfm

College level resources on radio astronomy:

- Essential Radio Astronomy (https://science.nrao.edu/opportunities/courses/era) - this is the notes for an upper level undergraduate (or lower level graduate) course on radio astronomy that I took. I have the textbook in my office, but the website is pretty complete.
- MIT Haystack tutorial (https://www.haystack.mit.edu/edu/undergrad/materials/RA_tutorial.html) - not super well formatted, but a good introductory source as well on radio astronomy

More related lesson plans:

- MIT Haystack hosts a "Research Experience for Teachers" along with their REU program. They post many of the lessons developed by these teachers at https://www.haystack.mit.edu/edu/pcr/resources/lessonplans.html