GLOBE 17th Annual Partner Meeting

D7: Accessing Landsat Data

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Tuesday Aug. 13
Accessing Landsat Data

- Introductions
- Intro to Remote Sensing and Landsat
- Using Landsat Data in GLOBE
- Getting data you can use!
- Using Multi Spec
- Wrap up

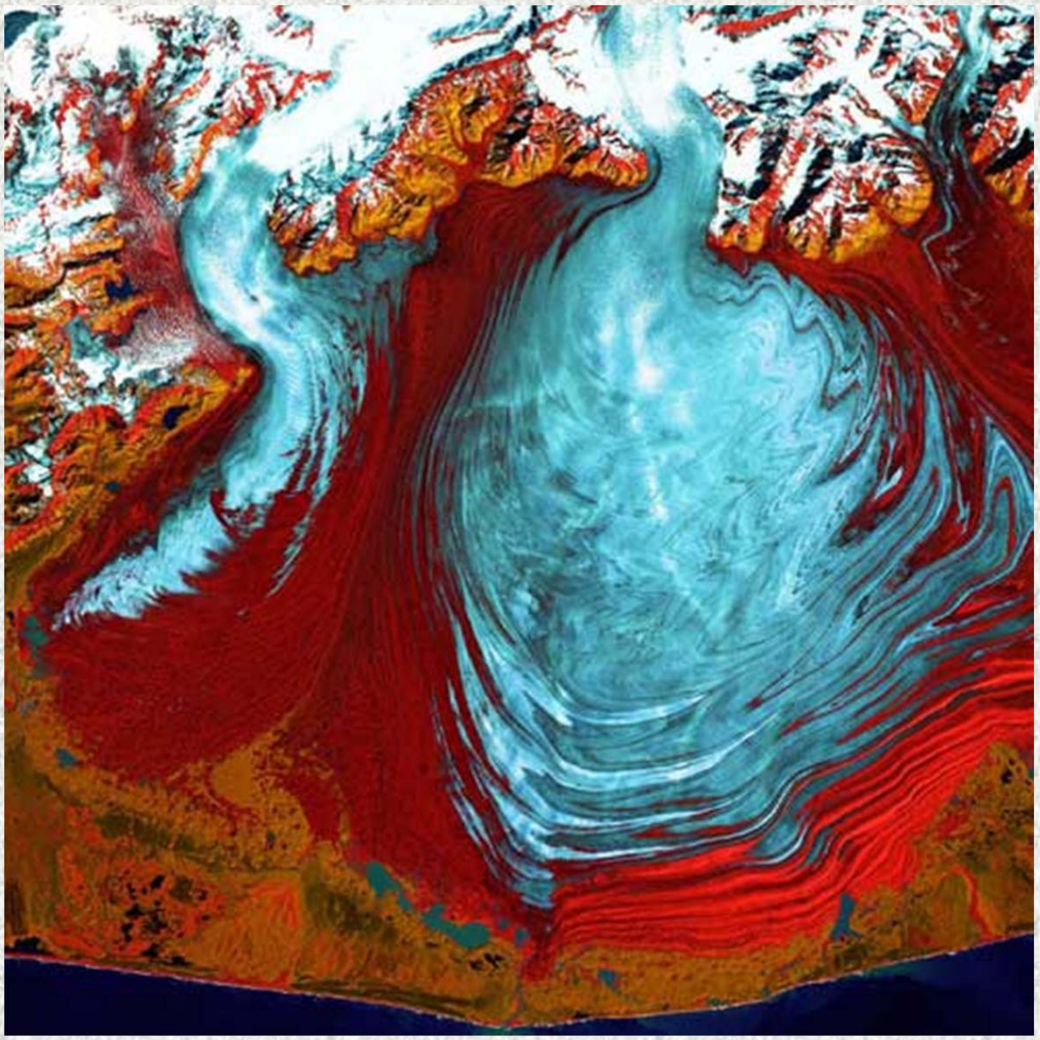
What’s Special About Landsat

What’s Special About Landsat

- Primary mission: to map Earth’s land surface
- Data consistent since 1972
- 16 day repeat
- 30-meter resolution
- Data publicly available at no cost, thanks to USGS.

More than a Pretty Picture:

How Landsat Images Are Made



Malaspina Glacier, Alaska

Colors in satellite images represent data about the Earth.

To understand what the colors mean we need to understand light

Landsat image of Betsiboka River, north-central Madagascar.

Light is energy that radiates from its source.

Photo: Jeannette Allen

All objects with a temperature above absolute zero (-273 degrees Celsius) reflect and emit energy that radiates through space.

Photo: Jeannette Allen

This **radiant energy** has electrical and magnetic effects, and so it can be called, “electromagnetic radiation.”

Photo: Jeannette Allen

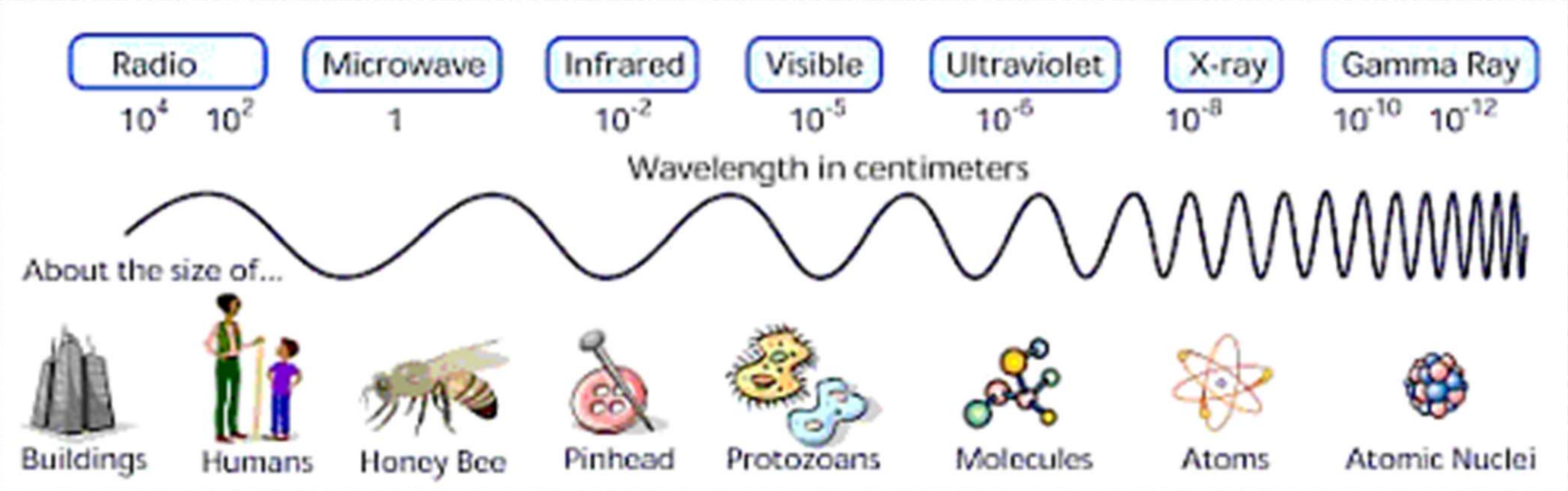
Electromagnetic radiation is the means for many of our interactions with the world.

You can see around you because of light energy. When you tune your radio, watch TV, send a text message, or pop popcorn in a microwave oven, you are using electromagnetic energy.

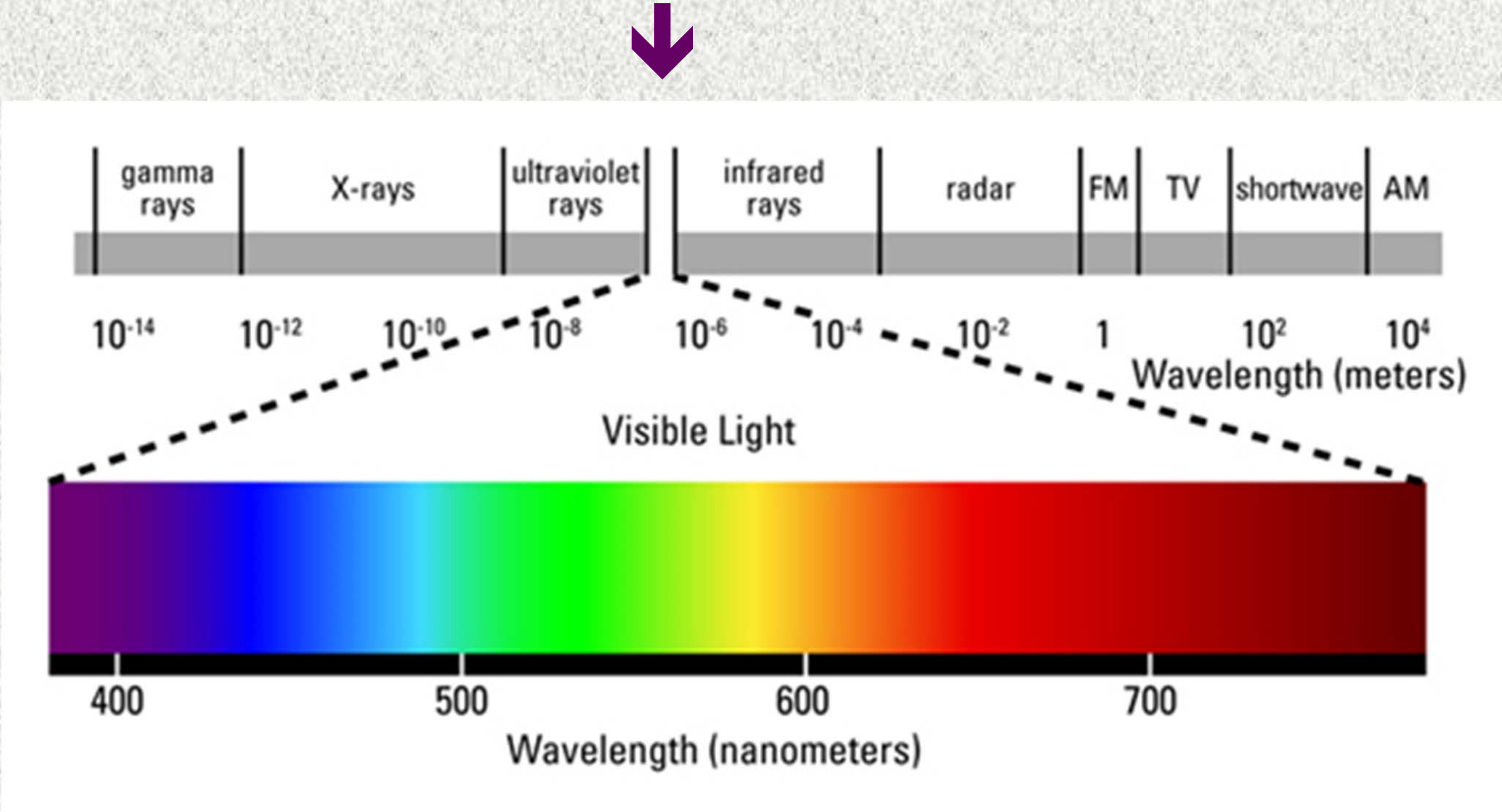
Photo: Jeannette Allen

The *entire* electromagnetic (EM) spectrum consists of the longest wavelengths (radio), shortest ones (gamma rays), and everything in between.

People have grouped EM waves into these categories in order to talk about them.



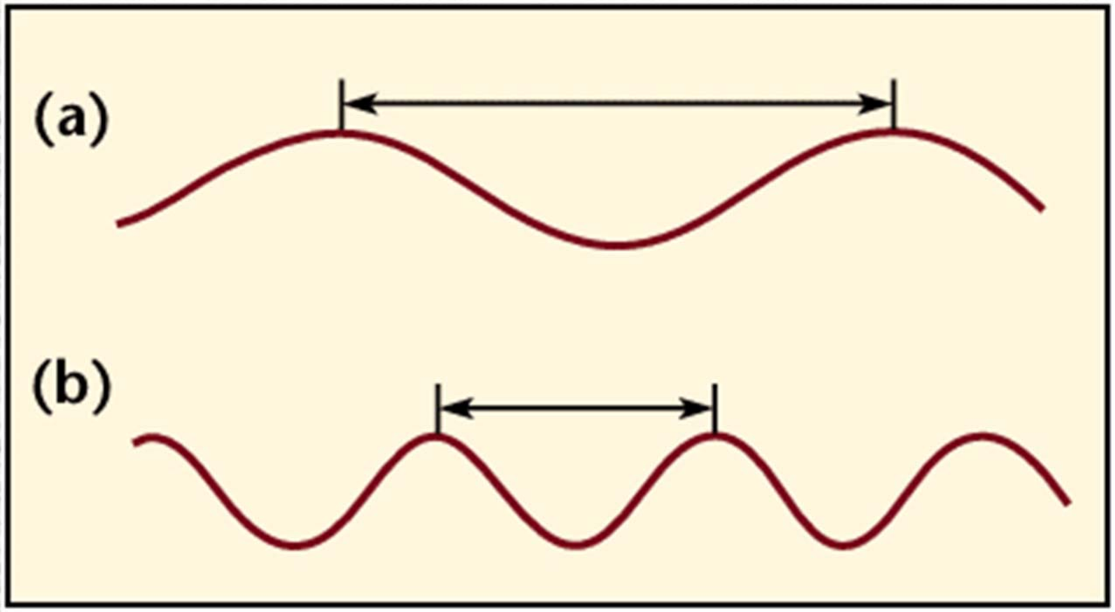
Visible light, the light we see with our eyes alone, is a *very small part* of the whole spectrum of radiant energy in the universe.



We measure radiant energy in **wavelengths**, from crest to crest.

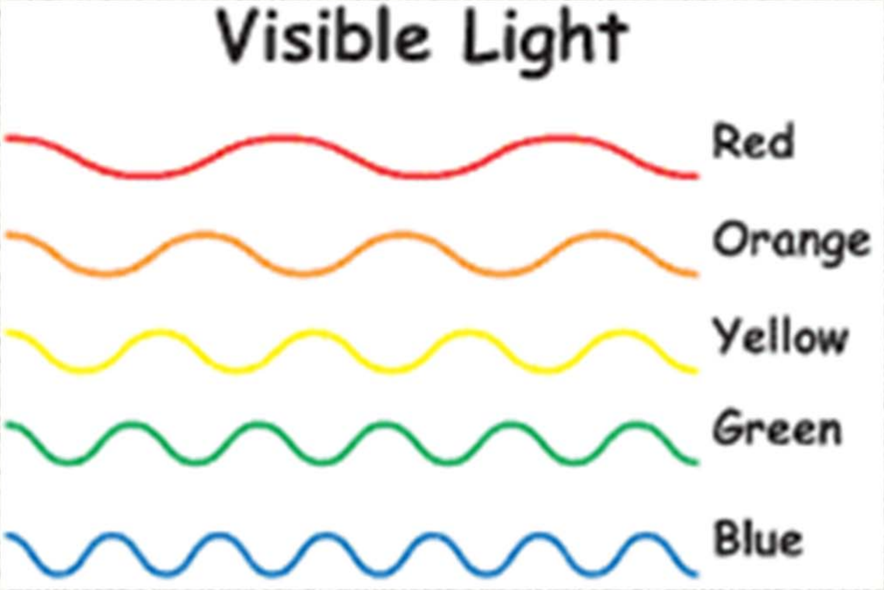
Wavelength (a) ➔
is longer

than wavelength (b)
➔



Colors have different wavelengths!

We see colors as different *because* they have different wavelengths.

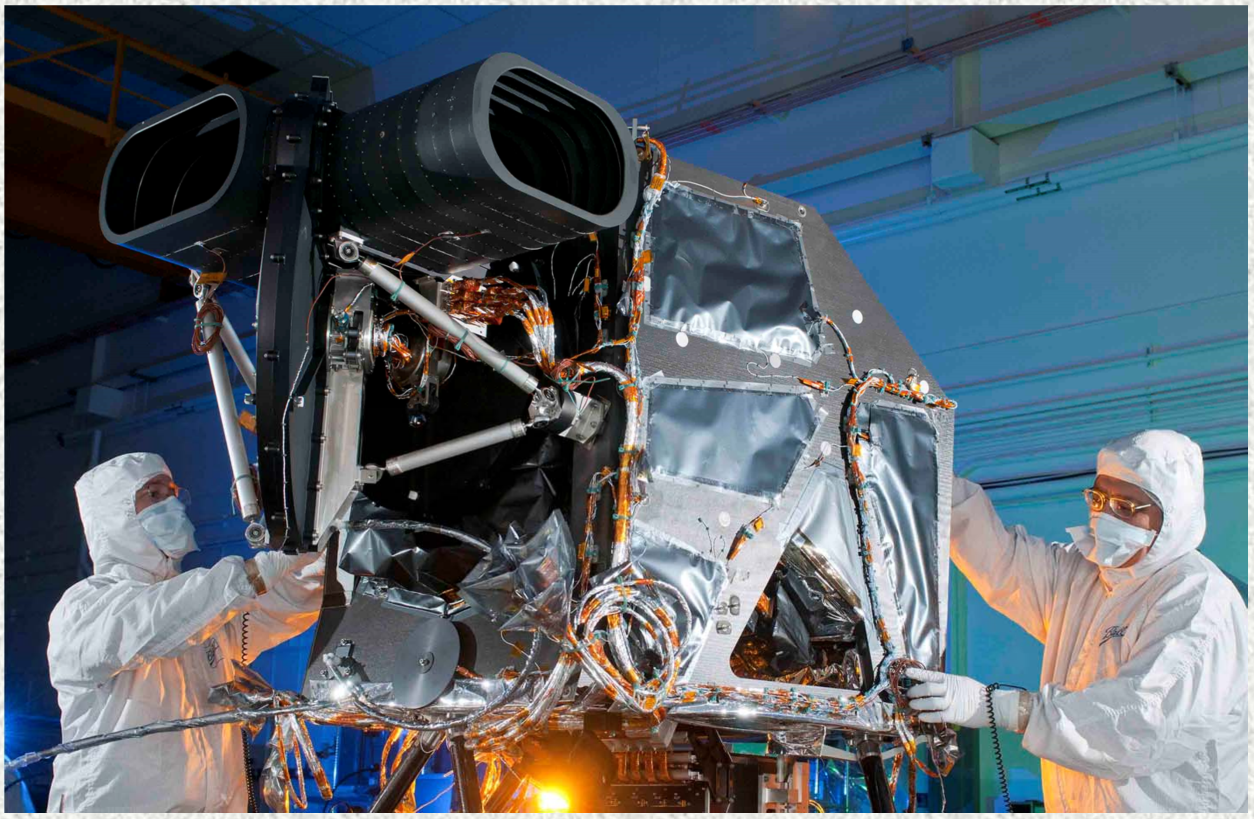


Red has the *longest* wavelengths of visible light.
Blue/purple has the *shortest* wavelengths of visible light.

Our eyes detect the entire visible range of those wavelengths, and our brains process the information into separate colors.

Photo: Jeannette Allen

Landsat instruments are *designed to detect* visible and infrared wavelengths.



The Operational Land Imager (OLI) under construction

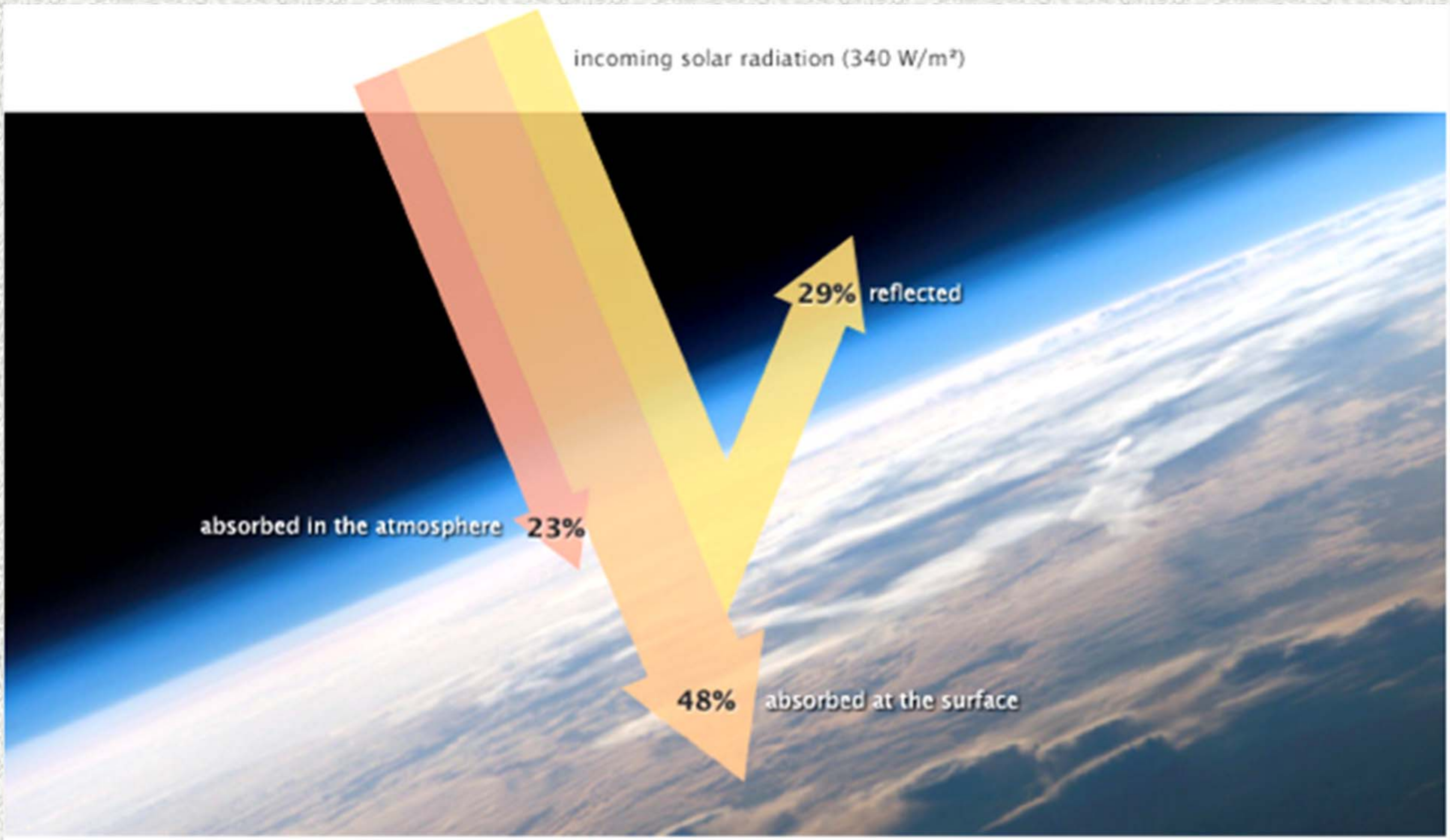
Landsat instruments measure primarily light that's *reflected* from Earth's surface.

To understand more about how Landsat sensors work, it helps to remember that –

As sunlight strikes Earth’s surface, some of it is absorbed, and some of it is reflected back into space.

Image Science & Analysis Laboratory, NASA Johnson Space Center - ISS007E10807

About 25 percent of the Sun's energy is *absorbed by the atmosphere*; about 50 percent is *absorbed by the Earth's surface*; and about 30 percent is *reflected back to space*.



NASA illustration by Robert Simmon. Astronaut photograph ISS013-E-8948

Sunlight has visible light *and* infrared light, as well light of other wavelengths.

Sunlight interacts with the objects it hits. Some of it is *absorbed* and some of it is *reflected* by those objects.

Photo: Jeannette Allen

We *see* the light that's ***reflected*** from objects.

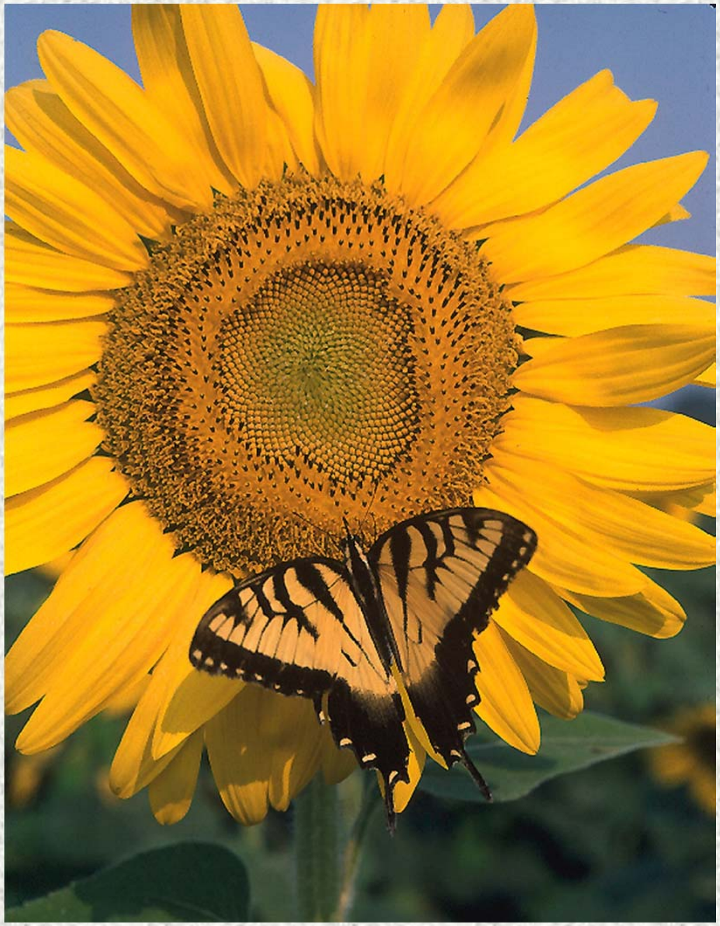


Photo: Jeannette Allen

Consider a tree and its leaves

Red, Green, Blue, and Infrared light from the sun hit the tree and its leaves.

Infrared and Green light are ***reflected*** from the tree.
Red and Blue light are ***absorbed*** by the tree.

In this picture,
IR is Infrared light
R is red light
G is green light
B is blue light

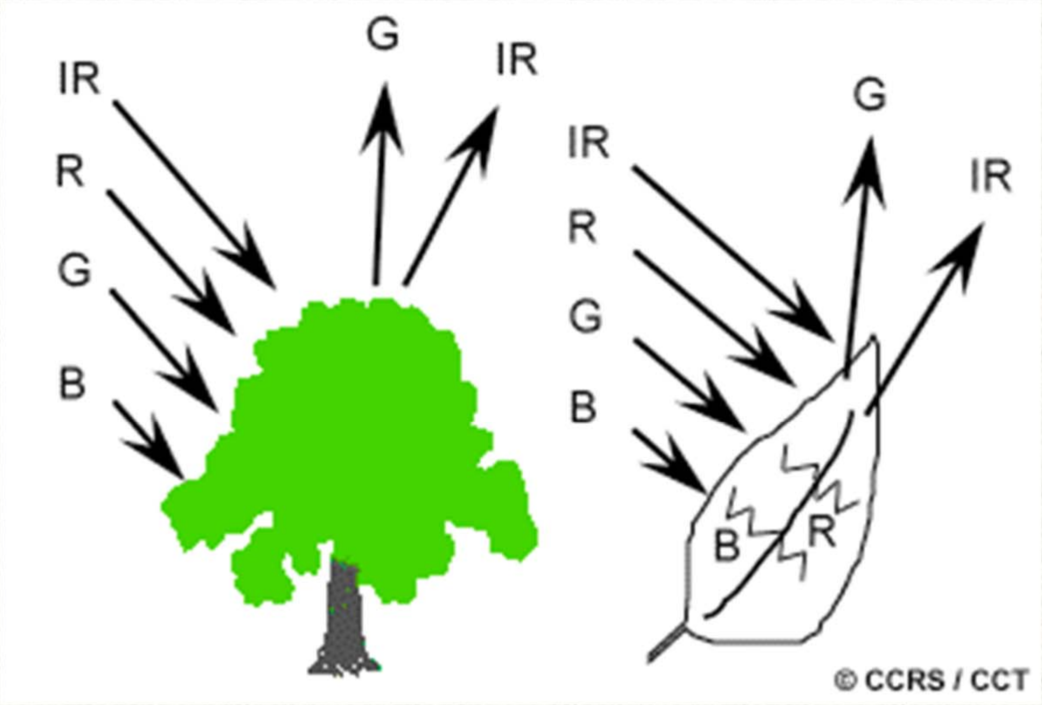


Image Credit: Canada Centre for Remote Sensing

We *see* the tree as green,
because wavelengths of light we call green are reflected to our eyes by the tree.

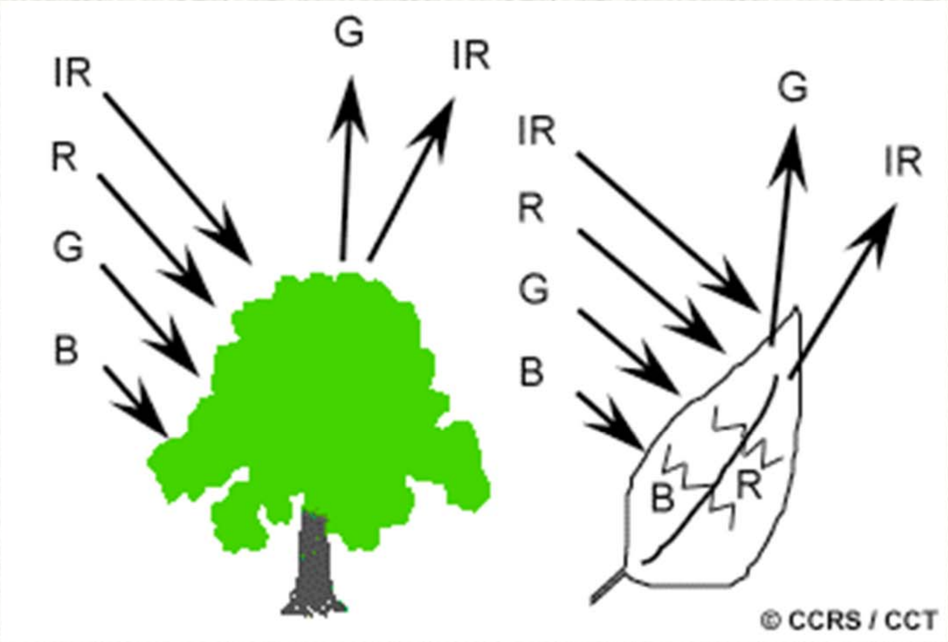
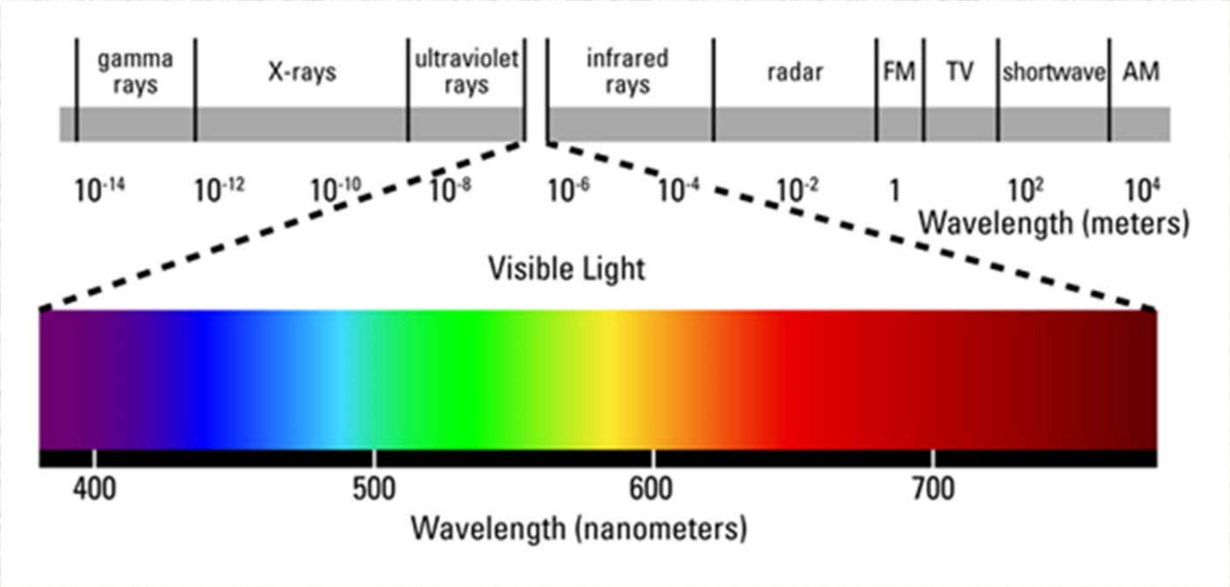


Image Credit: Canada Centre for Remote Sensing

Wavelengths we see as green are about 525-550 nanometers (nm) in length. Wavelengths we see as red are 630-800 nm in length.



The red petals of this poppy flower reflect strongly at wave-lengths of 700 nm.

Photo: Jeannette Allen

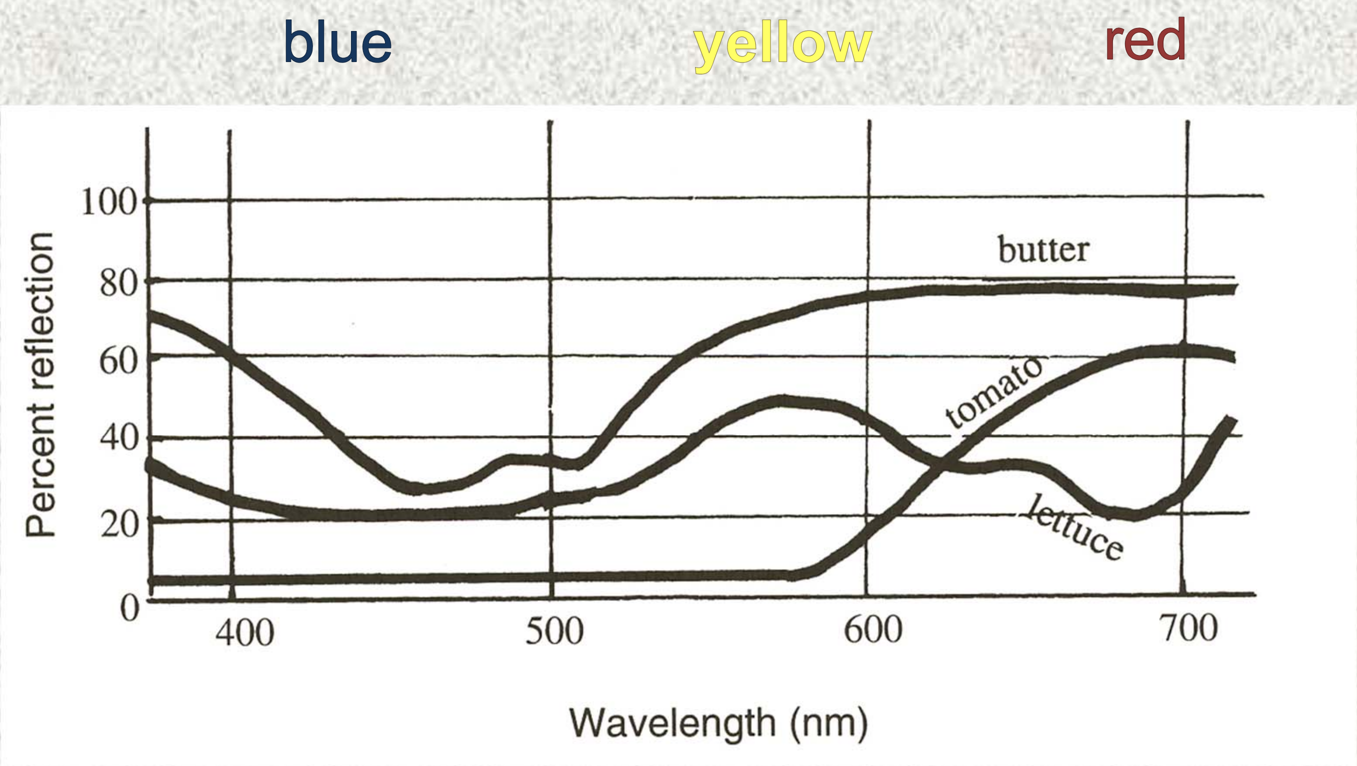
Every kind of surface reflects light differently, absorbing and reflecting it weakly or strongly in different wavelengths.

http://landsat.usgs.gov/tools_spectralViewer.php

Photos: Jeannette Allen

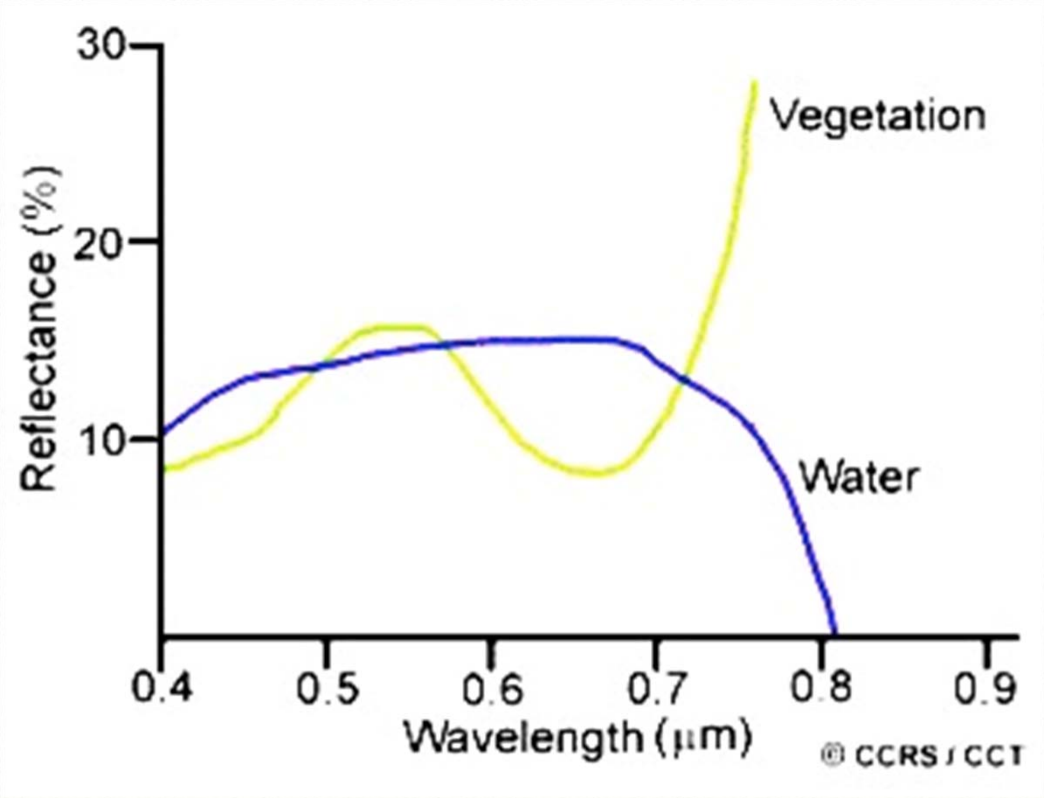
Every kind of surface has its own ***spectral signature,*** somewhat like a fingerprint.

Butter reflects weakly in blue and strongly in yellow to red.
Tomato reflects weakly in blue and strongly in red.



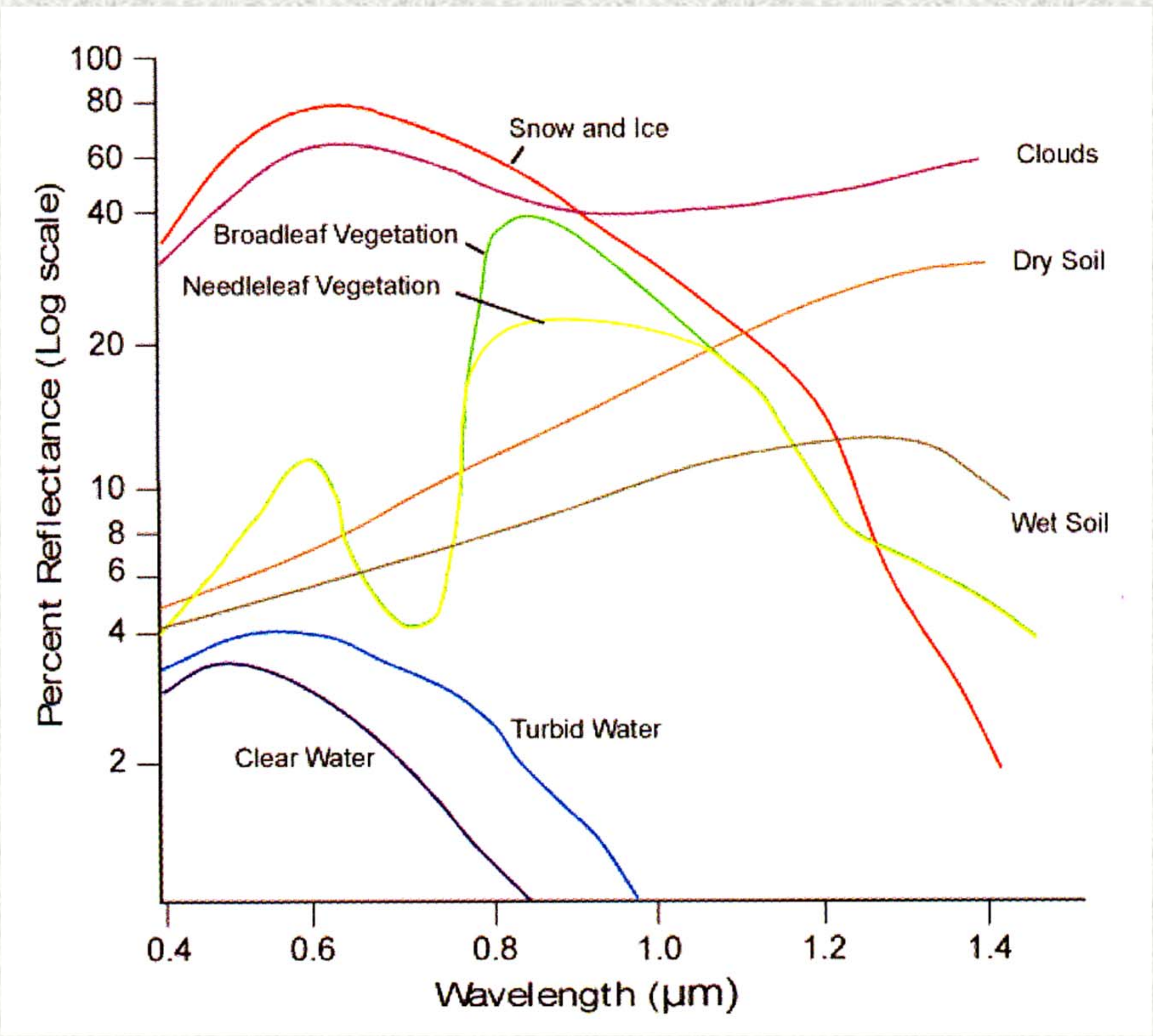
Spectral signatures of vegetation and water

Notice that water and vegetation reflect somewhat similarly in the visible wavelengths (about 0.4 to 0.7 nm) but are almost always separable in the infrared.



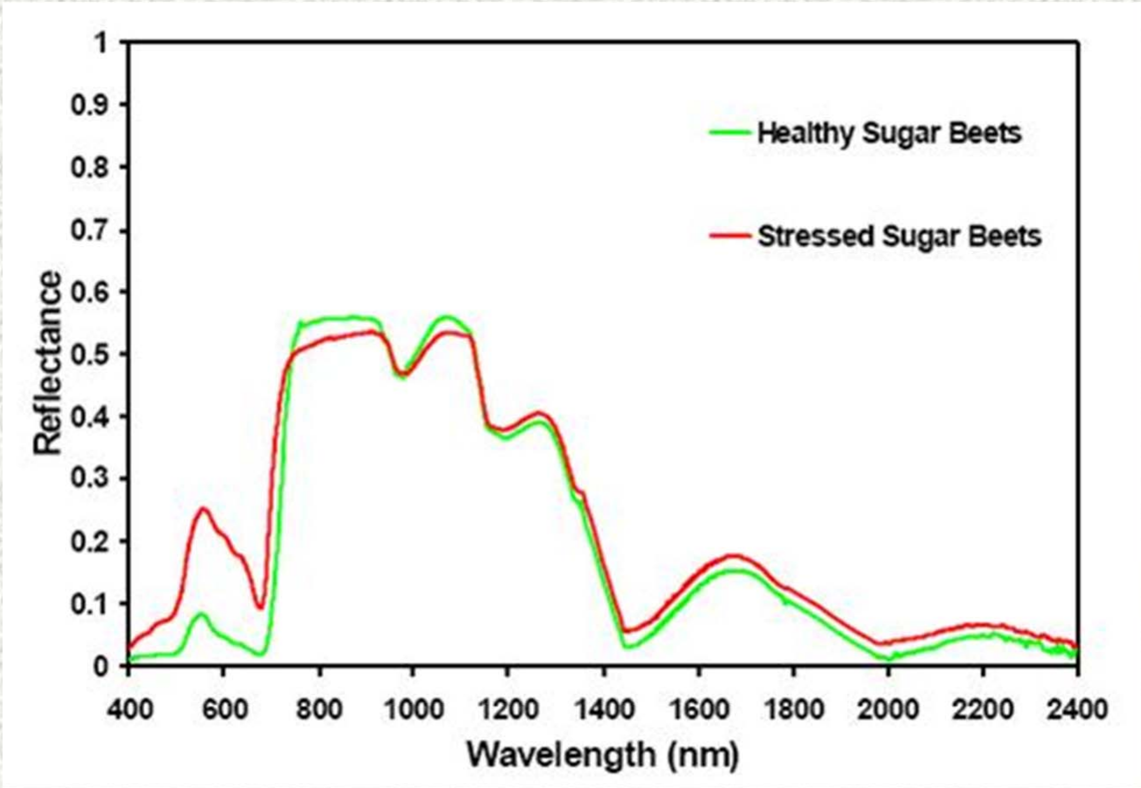
More spectral signatures

Notice how different kinds of surfaces reflect strongly or weakly at different wavelengths.



(This graph uses micrometers rather than nanometers.)

A farmer using remote sensing can tell which sugar beet fields are healthy and which are not, if she/he knows their spectral signatures.



If s/he were designing a sensor solely to measure the health of his sugar beets, what wavelength range would he want the sensor to detect?

People measure the spectral signatures of different surfaces on the ground. Then when they look at the spectral signature of a surface in a satellite image, they can tell what kind of surface the satellite was looking at.

Researcher with hand-held spectrometer

We use our understanding of spectral signatures when we study a Landsat scene.

Mergui Archipelago

The pathway of light used by Landsat

From Sun to ground, then reflected to Landsat, then transmitted to relay stations and sent to computers for analysis.

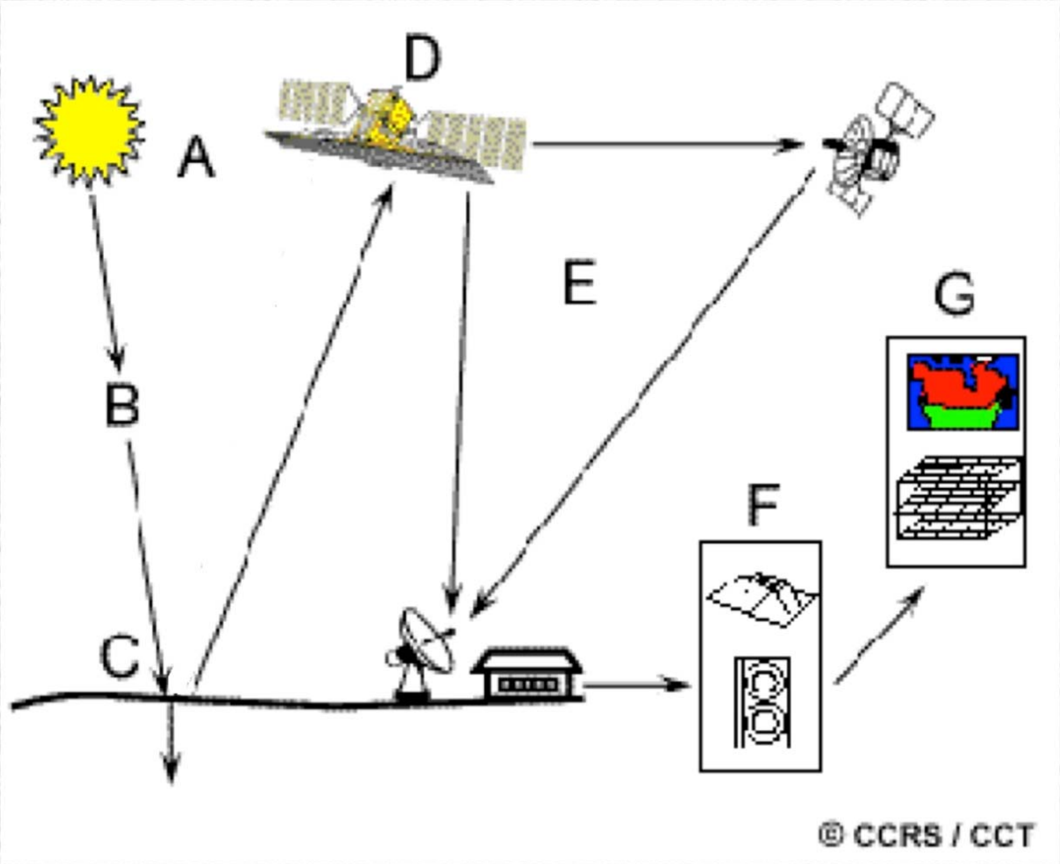


Image Credit: Canada Centre for Remote Sensing