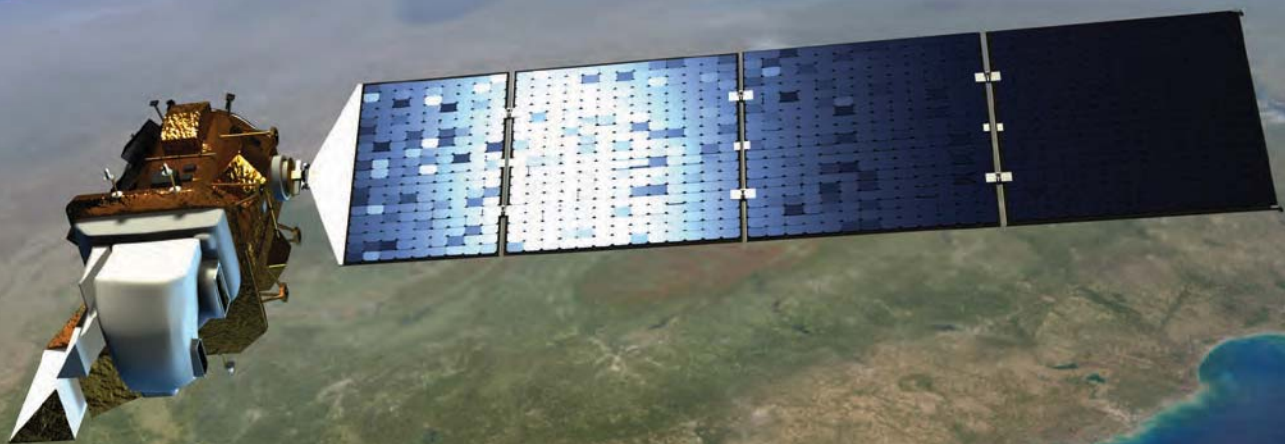




Smithsonian

Taking Photos from Space



Rane Anderson

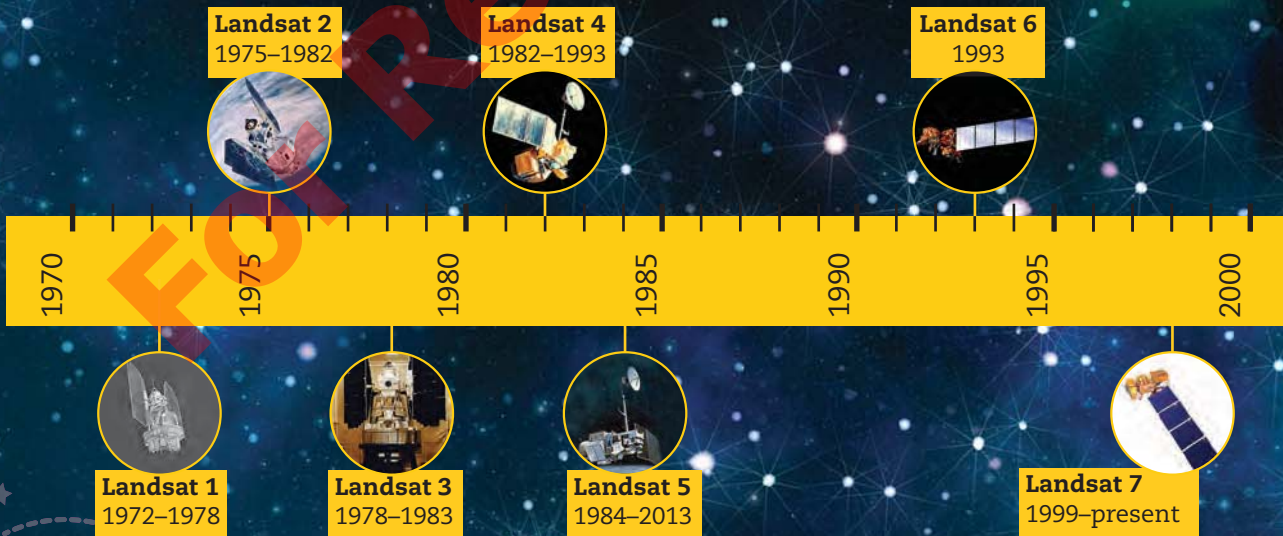
Table of Contents

Superhero Vision	4
The Big Picture.....	6
Seeing the Problem.....	12
Failures.....	18
Algae Blooms	22
The Next Generation.....	26
STEAM Challenge.....	28
Glossary	30
Index	31
Career Advice.....	32

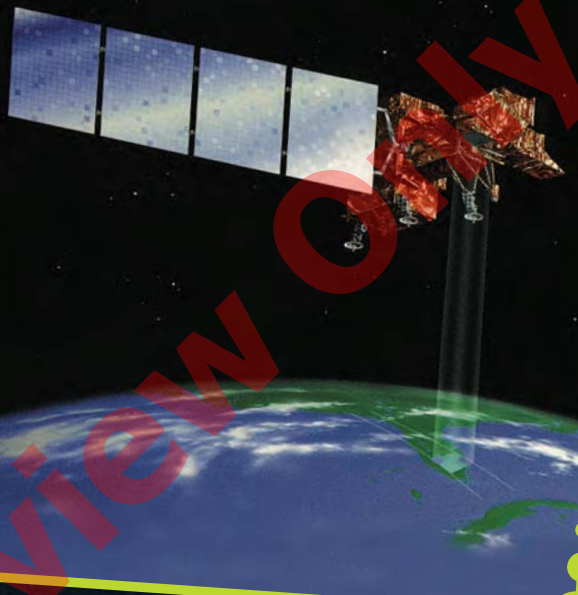
Superhero Vision

Would you like to be a superhero with superhuman vision? You could spot a disaster from miles away. You could stop a forest fire. You could put an end to starvation and drought. Well, you might not be a superhero. But you could still do all those things with the help of a series of satellites called Landsat.

These satellites have infrared vision. That means they can see heat. And that helps them see things that humans cannot. From space, satellites take photos of Earth's surface. Then, scientists study the photos. They compare them to images that were taken weeks, months, or even years before. They look for signs of trouble. If they find any, a team of scientists and engineers starts brainstorming ways to fix it.



This drawing shows how Landsat 7 takes pictures of Earth.



Landsat 8
2013–present



2005

2010

2015

2020

2025



Landsat 9
2020/2021

The Big Picture

Imagine your nose pressed up to a painting. What do you see? Odds are, you cannot describe the painting in much detail. You are too close to the canvas to see the whole picture. Some things, such as paintings, make more sense when viewed from a distance. With your feet on the ground, you are very close to Earth's "canvas." From the ground, you can learn a lot about the world. But the world is a big place, and you are only seeing a small part of it. Some things on Earth are too difficult to understand without taking a step back.

Remote sensing does just that. It gives views of Earth from high above the ground. It uses satellites in space or high-flying aircraft to make images of Earth's surface. It allows scientists to see a big part of the planet at one time. That helps them make big discoveries.



San Diego, a city in California, looks very different from land (left) than it does from space (above).

There are many satellites that orbit Earth collecting data.



Before remote sensing, people had to get creative to take a picture of Earth from the sky. They attached small cameras to balloons, kites, and even pigeons!

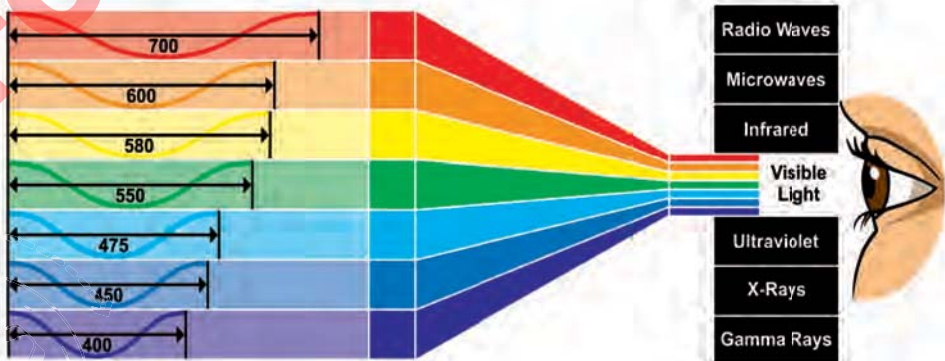
Make Some Waves

The sun shines on Earth from space. What do you feel when you are outside on a sunny day? The sun makes your body warm. And it helps you see everything around you. Heat and light are two forms of **electromagnetic radiation**. These waves of energy and light are what make Landsat images possible!

There are many types of radiation that come from the sun. **Visible light** is the type people can see. **Infrared light**, felt by most people as heat, is a type of light people cannot see. Scientists use both to study Earth from space.

Both types of light move in waves. Imagine that you tie a piece of string to a chair. You hold the other end and flick your wrist up and down. The string moves in waves. You can move it faster and slower. This will make different **wavelengths**. Light and heat move in waves just like the string. Landsat sensors can measure the length of waves. Some are tiny, and others are miles long.

Wavelength in nanometers



This photo shows how a lighthouse would look in ultraviolet light, which can't be seen by the human eye.



MATHEMATICS

Wavelengths

Scientists classify light by measuring the length between its waves. Violet light has the shortest waves that we can see. Red light has the longest. The infrared light has a wavelength that is even longer than red. Sensors on Landsat collect these lengths as data. The data help make infrared images.

STEAM CHALLENGE

Define the Problem

Scientists used Landsat 5 images of Lake Erie to see the effects of algae blooms. Now, scientists want to collect more data on-site. Your task is to design and build a tower to support a camera. The camera will take many images a day. Studying the images may help scientists find solutions to the problem.



Constraints: You may only use newspaper and masking tape to build the tower. The top of the tower must have a stage to fit an empty 12-ounce can that will represent a camera.



Criteria: Your model must support a can for 30 seconds.





Research and Brainstorm

How have scientists used Landsat images? Why was it helpful to see images of Lake Erie from above? Where do towers need to be strongest?



Design and Build

Sketch your design. How will you design the base? How will you make the tower tall as well as stable? Build the model.



Test and Improve

Place the can on the stage for 30 seconds. Did it work? How can you improve it? Modify your design, and try again.



Reflect and Share

Can you make the tower taller? What other materials can you use? Can you think of other ways that scientists can monitor the lake?

