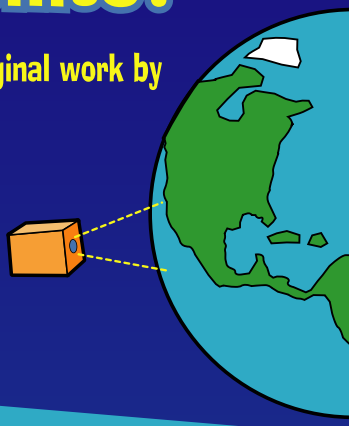
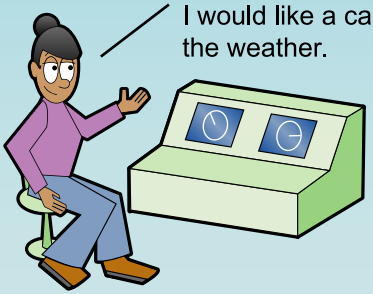
How Do You Make a Weather Satellite?

This booklet was adapted from the original work by

Ed Koenig





I'm a weather forecaster.
I need to see clouds and storms from way up high.
I would like a camera in space to help me predict the weather.

NOAA National Weather Service

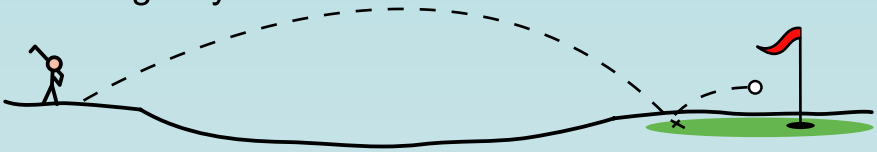
OK! I have an idea how to do that.

Cool! But how would you get a camera into space? And how would you get the pictures back to Earth?

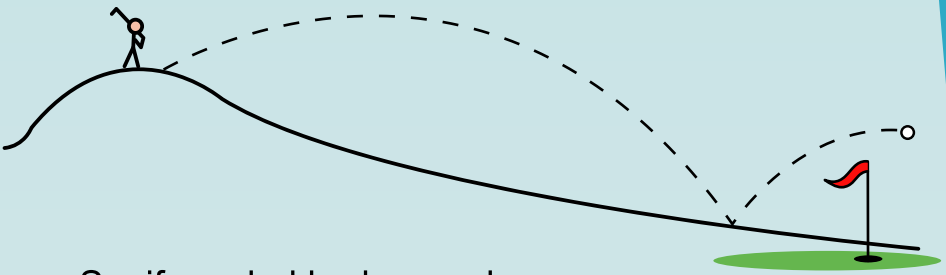
Well, first let's talk about how you get anything into space and keep it there without it falling back to Earth.

Let's imagine a golf ball.

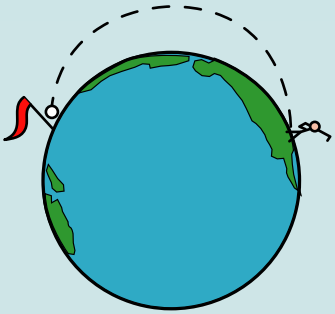
Now, my dad is a pretty good golfer. When he hits the ball with a club, it goes a long way



But if he hits it from the top of a hill, it goes even farther.

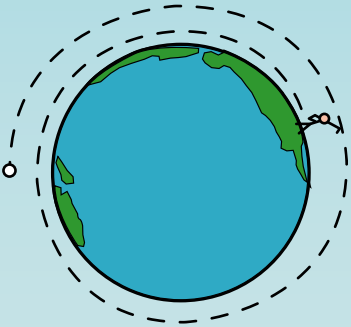


So, if my dad had super-human strength, do you think he could hit the ball all the way to the other side of the world?



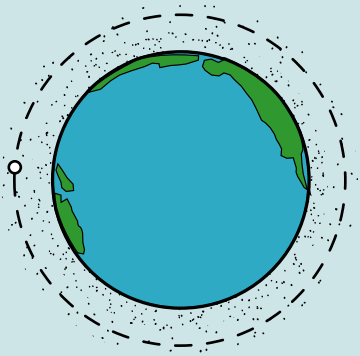
Maybe!

If my dad were as strong as some super hero, he could hit the ball so hard and make it go so fast—about 17,000 miles per hour—that it would "fall" all the way around Earth!



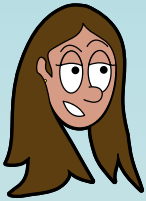
It would become a **Satellite!**

If the ball could be thrown way up above most of Earth's atmosphere, there would be very little air to slow it down. So it could keep going around and around for a long time.



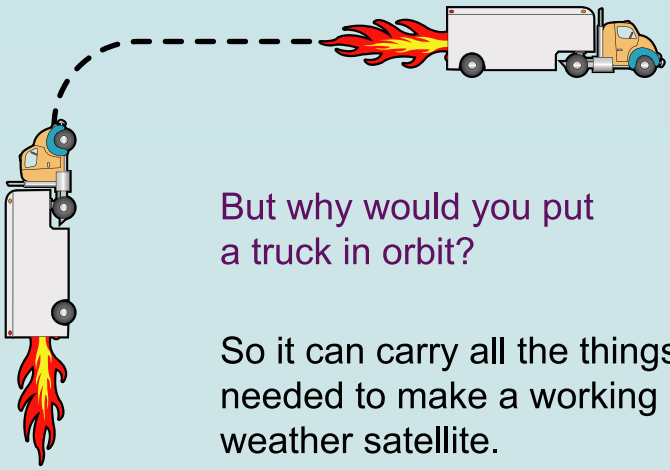
If it would take the strength of a super hero to throw a golf ball around the world, imagine what it would take to throw a truck around the world!

A truck!? Could you even do that?



Sure!

Just attach the truck to a rocket and blast off. When the rocket gets above the atmosphere, have it turn and throw the truck. The truck will be in orbit.



But why would you put a truck in orbit?

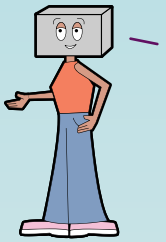
So it can carry all the things needed to make a working weather satellite.

Like what?

One of the things we will need is an instrument to tell whether it's hot or cold down below.

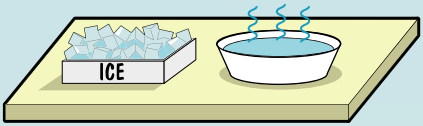
How will that work?

I'm glad you asked! Would you like to try being a satellite temperature sensor?



Who, me? OK, I'll try.

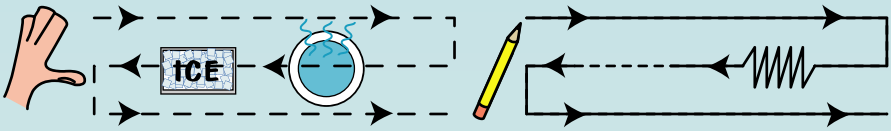
Good! In your kitchen, place a tray of ice near a bowl of hot tap water.



Move your hand over the ice, then over the hot water. Do you feel the difference?

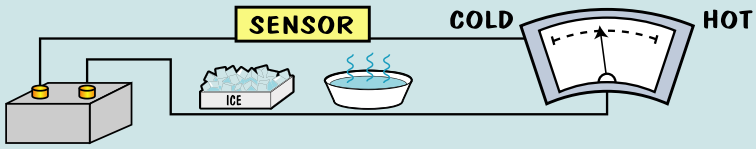
You are now a heat sensor! To give your temperature reading, say "Hmm" if you don't feel any particular temperature. Say "Brrr" when you feel cold. Say "Wow" when you feel heat.

Meanwhile, I'll be the weather forecaster and draw on a chalkboard or paper.
I'll move the chalk or pencil in the same direction as your hand is moving, making a straight solid line for "Hmm," a zig-zagged line for "Wow," and a dotted line for "Brrr."

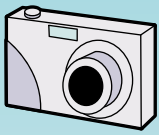


The cold area could be the North Pole or a cloud. The hot area could be a desert.

Instead of a hand in orbit, satellite builders use a little sensor chip, which changes an electrical current, depending on whether it senses hot or cold.

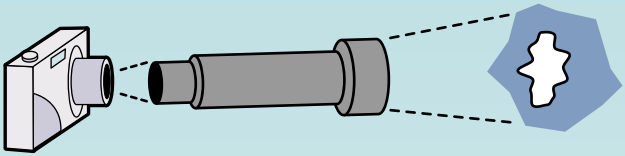


We will also need a camera, of course. It will be a digital camera with images recorded electronically.



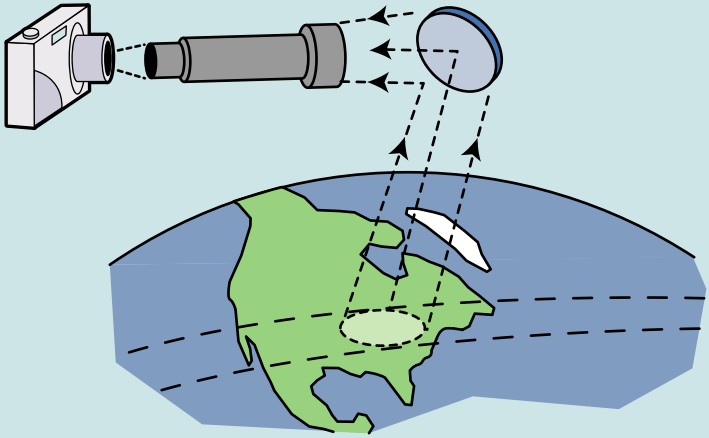
But how can the camera see a cloud from way up in space?

Have the camera be attached to a telescope!



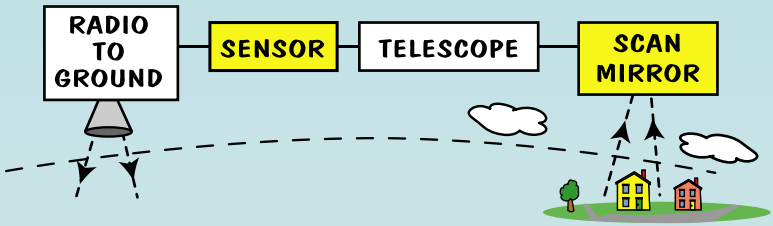
But won't a telescope see only a tiny part of Earth at a time?

Good thinking! So, use a moveable mirror to scan around and reflect the image of different parts of Earth into the telescope lens. That way, the camera can record pictures of each of the different views.

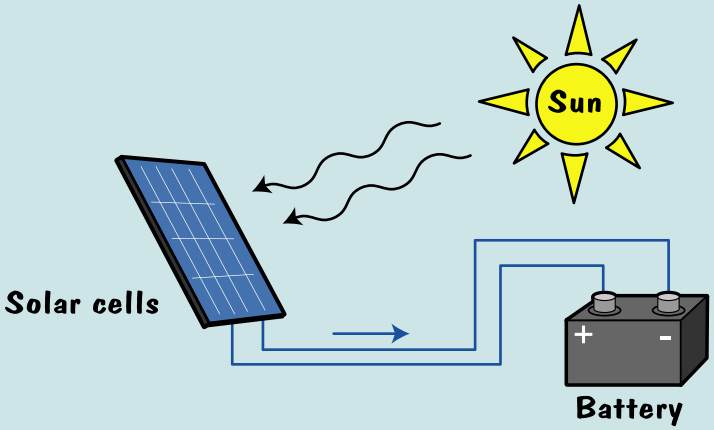


Now we have our sensor, telescope, and scan mirror. What else do we need?

Communication! We need a transmitter to send information from the satellite to the satellite operations control center on Earth. And we need an antenna on the satellite so it can receive instructions from the command center.



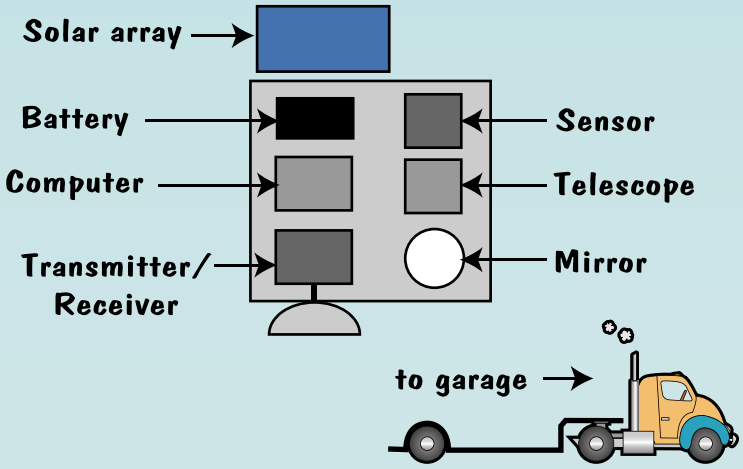
We will also need a way to make and store electricity for the camera, scan mirror, transmitter, and a computer to control everything.
We can use solar cells to convert sunlight to electricity, and batteries to store the electricity.



But what about the truck?

Oh, right! We fill it with sensors, telescope, scan mirror, transmitter, antenna (to receive signals from Earth), solar cell array, and batteries, plus a computer and controls to operate everything.

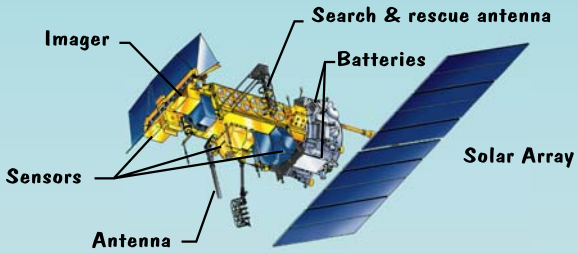
We don't need the cab, engine, or wheels, so let's leave them behind.



Now, send it into orbit and let it get to work!

Here are some real weather satellites

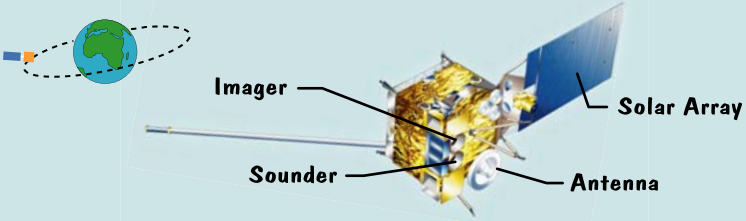
This one is called a POES.



It orbits 14 times a day, about 500 miles above Earth. It passes nearly over the North and South Poles. With Earth rotating below, each POES passes over your area twice each day. Heat sensors measure the temperatures of the oceans, the land, the air, and the clouds.

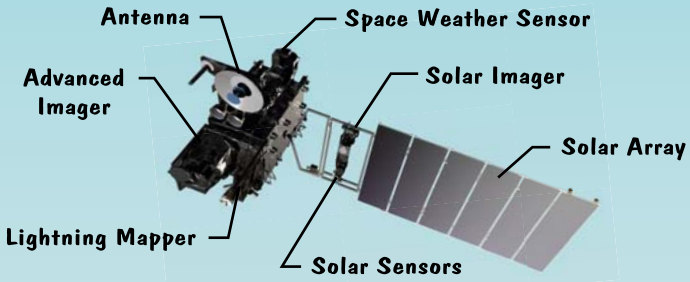
This one is called a GOES

It is called a Geostationary Operational Environmental Satellite, or GOES. It is in a special kind of orbit called geostationary orbit, 22,300 miles above Earth's equator. This is just the right distance for a satellite to make one orbit every 24 hours, the same time it takes Earth to make one rotation. So the satellite seems to always hover above a particular spot on the ground below.



Two GOES are on duty at all times, watching both east and west coasts of North America. They observe storms forming over land and ocean. They take the pictures of clouds and hurricanes you see on TV. The GOES also keep an eye on the Sun. Storms on the Sun affect us on Earth too.

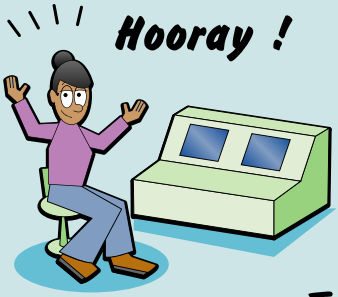
Here is a future type of very advanced weather satellite. It is called a GOES-R.



GOES-R will do everything the GOES can do, plus more. It will make even better images of Earth. It will map lightning. It will also study the Sun and Earth's magnetic field. GOES-R will gather more information and gather it faster.

NASA builds and launches these satellites. NOAA pays for and operates them. NOAA runs the National Weather Service, which uses information from GOES and GOES-R to predict weather days and weeks ahead. This information also helps scientists study how the climate is changing over longer periods.

Now the weather forecaster has the information she needs to do her job!



Glad I could help!

THE END

What have we learned?

NEW WORDS:

SATELLITE: A body (such as a spacecraft) in orbit around another larger body (such as Earth). The satellite's speed (momentum) keeps it from falling to Earth, and Earth's gravity keeps the satellite from flying off into space.

ORBIT: The path of a satellite around Earth (or another body) under a balance of forces.

SENSOR: A device that detects energy (such as heat or light) coming from a source.

NASA: National Aeronautics and Space Administration, the U.S. government agency that builds the GOES and GOES-R satellites, among many other things.

NOAA: National Oceanic and Atmospheric Administration, the U.S. government agency responsible for the weather service, among many other things.

NATIONAL WEATHER SERVICE: The U.S. Government agency (part of NOAA) that collects, interprets, and sends weather information to us.

GOES: Geostationary Operational Environmental Satellites, the high-Earth-orbiting satellites that stay over one place and take pictures continuously. GOES-R is the newest generation of high-tech GOES.

For more information:
http://www.noaa.gov
http://goespoes.gsfc.nasa.gov
http://goes-r.gov
http://www.nws.noaa.gov
http://scijinks.nasa.gov
http://coolcosmos.ipac.caltech.edu/cosmic_classroom/ask_astronomer/video/2002-001.shtml

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National Aeronautics and Space Administration

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