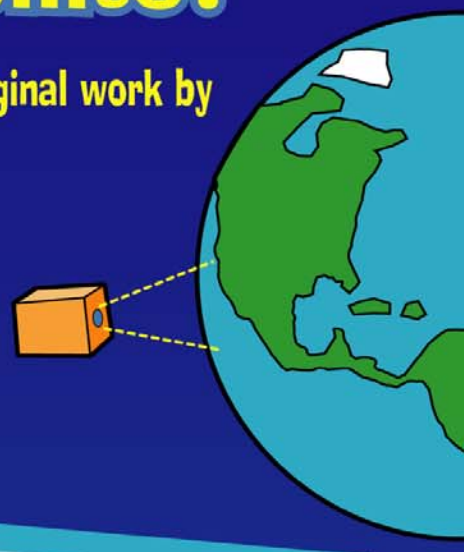
How Do You Make a Weather Satellite?

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.

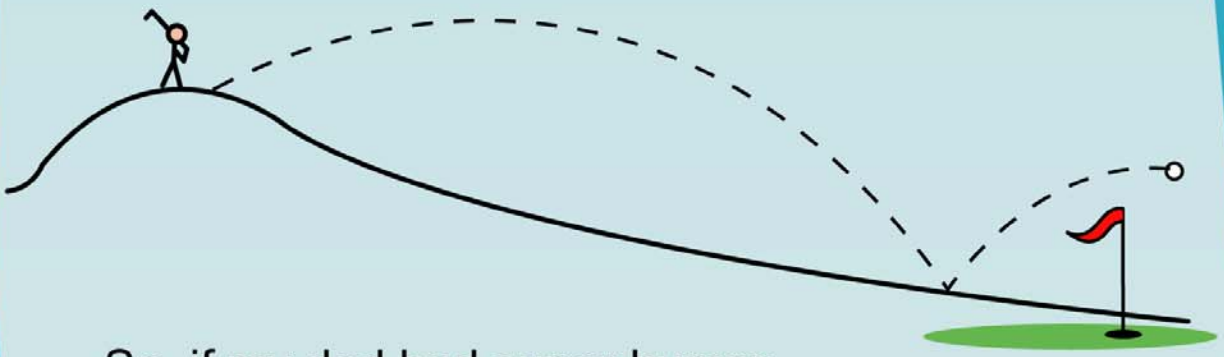
Cool! But how would you get a camera into space? And how would you get the pictures back to Earth?

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

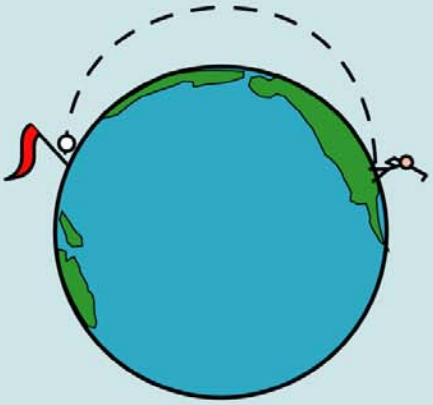
Let's imagine a golf ball.

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.

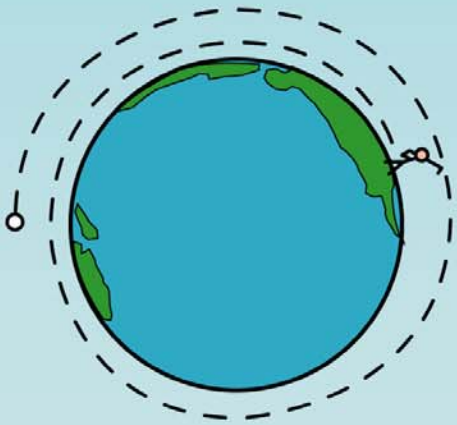


So, if my dad had super-human strength, do you think he could hit the ball all the way to the other side of the world?



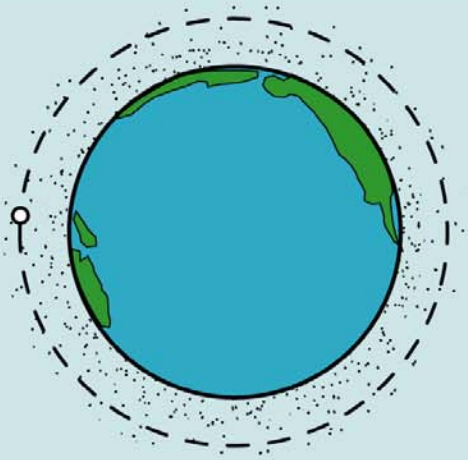
Maybe!

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.

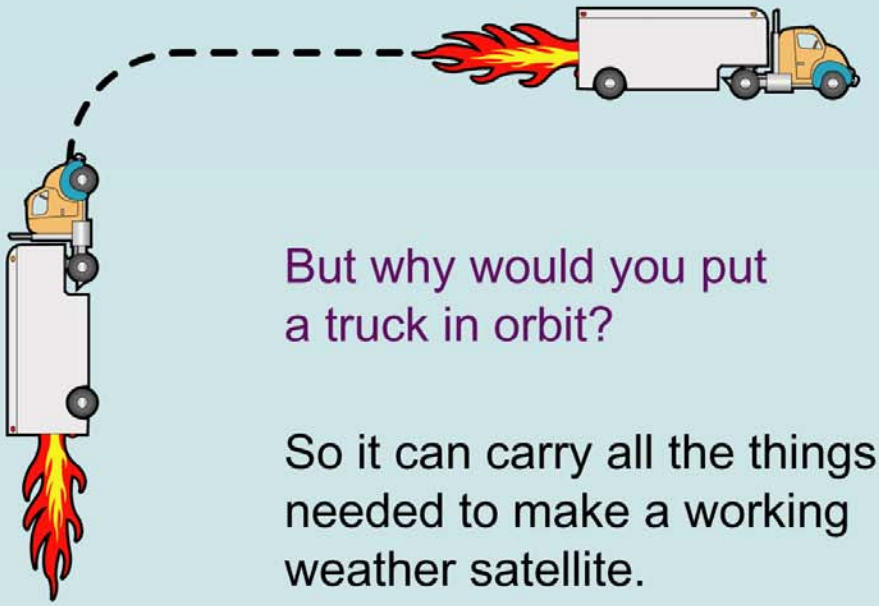


If it would take the strength of a super hero
to throw a golf ball around the world,
imagine what it would take to throw
a truck around the world!

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?

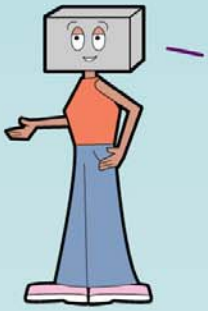
So it can carry all the things
needed to make a working
weather satellite.

Like what?

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

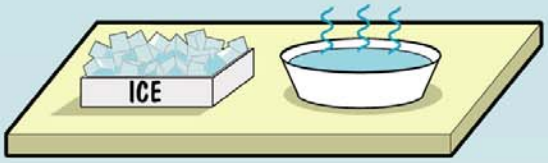
How will that work?

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."

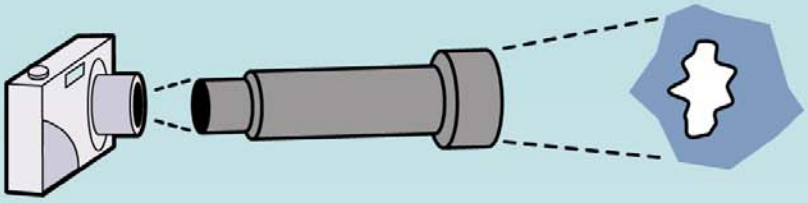
The cold area could be the North Pole or a cloud.
The hot area could be a desert.

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.
Better make it a digital-type camera,
since there will be no way
to get the film back.

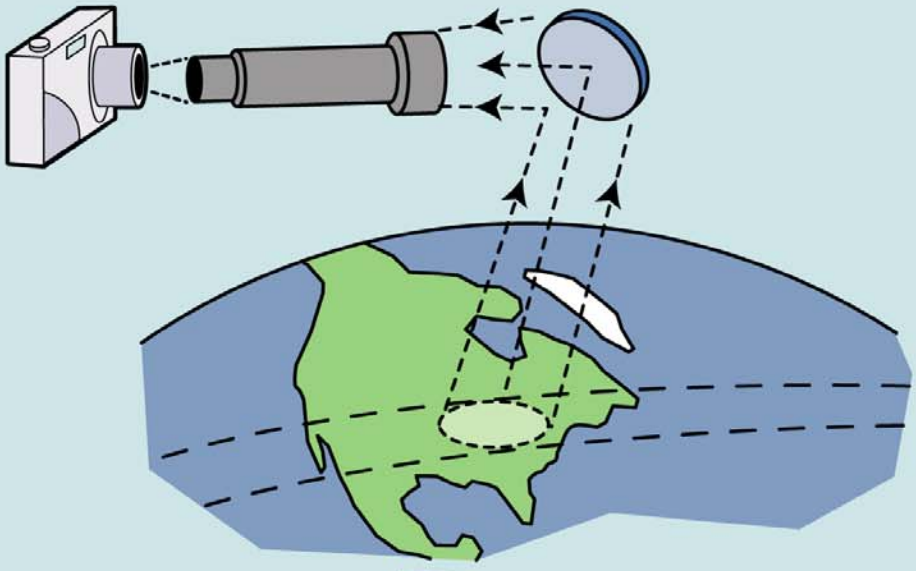
But how can the camera see a cloud
from way up in space?

Have the camera be attached to a telescope!



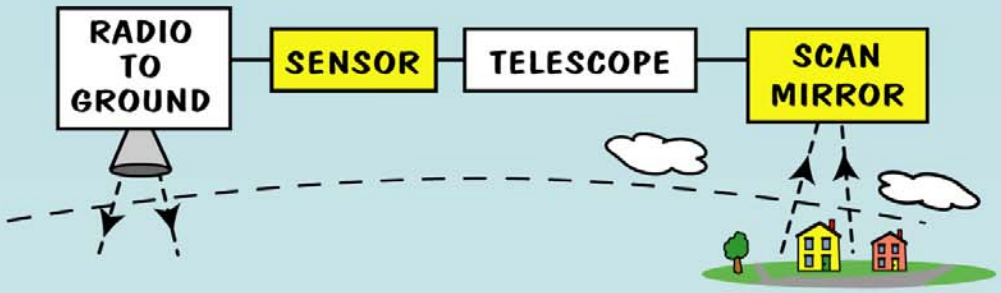
But won't a telescope see only a tiny part
of Earth at a time?

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.

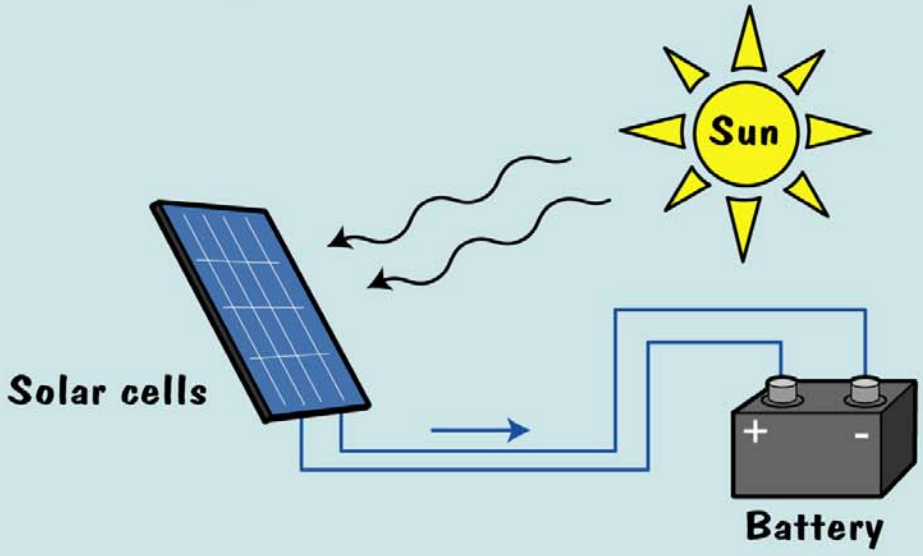


Now we have our sensor, telescope, and scan mirror. What else do we need?

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.



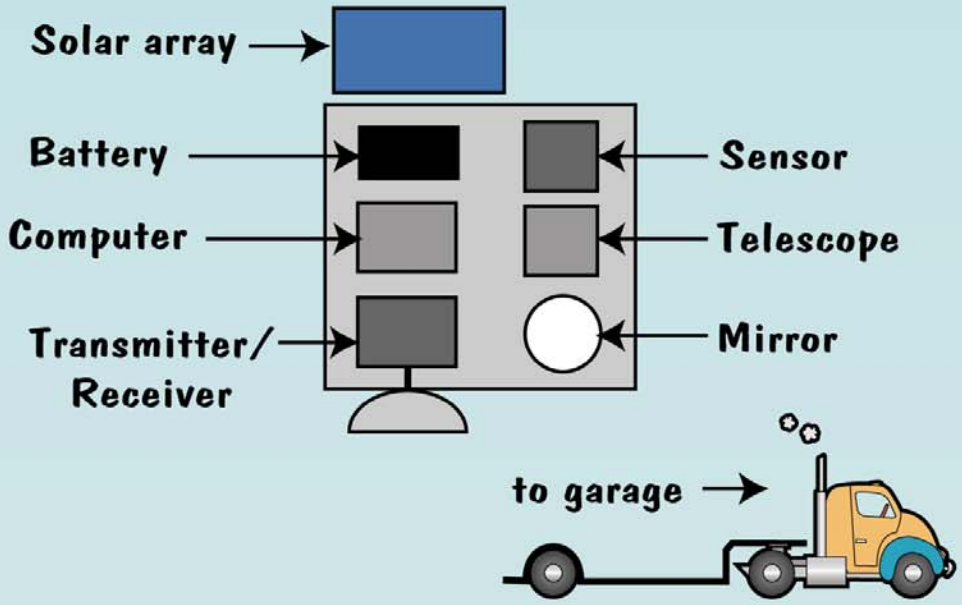
We will also need a way to make and store electricity for the camera, scan mirror, transmitter, and a computer to control everything. We can use solar cells to convert sunlight to electricity, and batteries to store the electricity.



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.



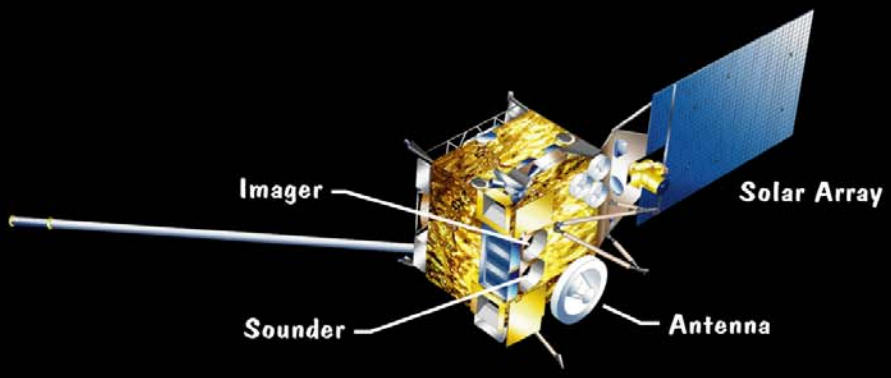
Now, send it into orbit and let it get to work!

Here is a real weather satellite.
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.

NASA builds and launches these satellites.
NOAA pays for and operates them.
NOAA runs the National Weather Service, which uses information from POES to predict weather days and weeks ahead.
This information also helps scientists study how the climate is changing over longer periods.
It helps with studies of vegetation, pollution, sea ice, ozone, and El Niño conditions.

Here is a different type of weather satellite.
It is called a GOES.



It orbits 22,300 miles above Earth's equator.
This is just the right distance for a satellite
to make one orbit every 24 hours.
Can you guess what that means?
Right! Because Earth rotates on its axis
once every 24 hours, the GOES will seem
to be hovering over the same spot on Earth
all the time. The GOES can thus take pictures
continuously of storms forming over land
and ocean. It takes the pictures of clouds
and hurricanes you see on TV!

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

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 POES 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.

POES: Polar-orbiting Operational Environmental Satellites, the low-Earth orbiting satellites that pass overhead twice each day.

GOES: Geostationary Operational Environmental Satellites, the high-Earth orbiting satellites that stay over one place and take pictures continuously.

For more information:

http://www.noaa.gov
http://goespoes.gsfc.nasa.gov
http://www.nws.noaa.gov
http://rsd.gsfc.nasa.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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