National Aeronautics and Space Administration

ACTIVITY SHEET

NASA Space Communications and Navigation

Measurement and Conversion of Measurements

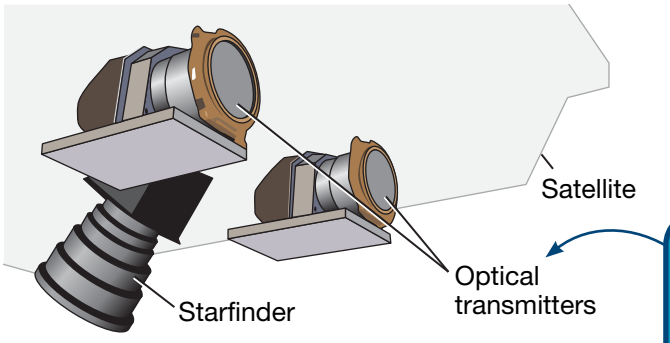
GRADES 3–5

The National Aeronautics and Space Administration (NASA) reaches for new heights and reveals the unknown for the benefit of humankind. To accomplish this mission, NASA launches satellites that study the universe. NASA's space communications and navigation equipment allows these satellites to communicate data about our planet and the solar system back to Earth.

To launch a satellite into space, you need a rocket. Heavier satellites need bigger rockets, so NASA tries to make the satellites weigh as little as possible. Help NASA check how much its upcoming satellite will weigh by looking at the table below:

Components	Weight	Number of Components
Structure	200 kg	1
Computers	90 kg	2
Solar Panels	12 kg	4
Batteries	57 kg	2
Cameras	20 kg	3
Radio Transmitter	42 kg	1

REMEMBER: On Earth, 1 kilogram (kg) weighs 2.2 pounds (lb).



EXAMPLE

How much do just the computers, cameras, and structure weigh?

STEP 1 Multiply the weight of each component by how many of them there are:

200 kg × 1 structure = 200 kg

90 kg × 2 computers = 180 kg

20 kg × 3 cameras = 60 kg

STEP 2 Then add up your results:

200 kg + 180 kg + 60 kg = **440 kg total weight**

PROBLEMS

1. What is the total weight of the satellite?

2. Optical transmitters, which use lasers instead of radio waves to send more data, weigh less and need less power. If the optical transmitter weighs 7 kg, how much ***less*** does it weigh than the radio transmitter?

(continued)

"**Optical**" means "relating to sight." Human eyes see light in a similar way. Optical communications use telescopes **both** to send flashes of light **and** to see them from far away. This allows NASA to send and receive information—from space—with light.

PROBLEMS *(continued)*

3. If we remove the radio transmitter and replace it with an optical transmitter, what is the new total weight of the satellite?

4. Since our new optical transmitter uses less power, we can also remove one solar panel and one battery.

a. What is the new total weight of the satellite?

b. How much weight have we removed since we started?

NASA's Laser Communications Relay Demonstration (LCRD) is the next step in optical communications.

Hosted on a U.S. Space Force spacecraft, LCRD will demonstrate optical technology in geosynchronous orbit (which means the spacecraft will stay over the same part of Earth) 22,300 miles above Earth's surface. LCRD is built and managed by NASA's ***Goddard Space Flight Center*** in Greenbelt, Maryland.

LCRD is a technology demonstration that will pave the way for future optical communications missions. When NASA has developed a new way to solve a problem and wants to show how it works, they create a technology demonstration. LCRD's first orbiting experimental user will be the International Space Station's Integrated LCRD Low-Earth Orbit User Modem and Amplifier Terminal (***ILLUMA-T***). The equipment will receive science data from experiments and instruments aboard the space station and then transfer the data to LCRD, which will then transmit them to a ground station. After the data arrive on Earth, they will be delivered to operation centers and scientists to help make decisions about the mission.

LEARN MORE

Learn more about LCRD's predecessor, the Lunar Laser Communications Demonstration (LLCD), at ***http://go.nasa.gov/LLCD_history***.

Learn more about LCRD at ***http://go.nasa.gov/LCRD_overview***.