National Aeronautics and
Space Administration

Goddard Space Flight Center

Black Brant XII Sounding Rocket

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Sounding Rockets

What Are Sounding Rockets?

Sounding rockets take their name from the nautical term "to sound" which means to take measurements. They are basically divided into two parts—a solid fueled rocket motor and the payload. The payload is the section which carries the instruments to conduct the experiment and send the data back to Earth.

The National Aeronautics and Space Administration (NASA) currently uses 13 different sounding rockets. The rockets come in a variety of sizes from the single-stage Super Arcas which stands 7-feet (3 meters) high to the four-stage Black Brant XII which stands at 65-feet (20 meters) tall. These rockets can carry scientific payloads of various weights to altitudes from 30 miles (48 km) to more than 800 miles (1,287 km).

Why NASA Uses Sounding Rockets

Sounding rockets are low cost and the payload can be developed as quickly as six months. These rockets allow scientists to conduct investigations at specified times and altitudes. The experiments provide a variety of information on the upper atmosphere, the Sun, stars, galaxies and other planets.

NASA launches an average of 25 sounding rockets each year with a success rate of about 99 percent. They are launched routinely from established sites as Wallops Island, Virginia; White Sands Missile Range, New Mexico; and Poker Flat Research Range, Alaska, as well as sites in Canada, Norway and Sweden.

Sounding rockets also can be launched from temporary launch ranges. In the past, launch programs have been conducted from Peru, Puerto Rico, Greenland, Australia and even from an aircraft carrier in the Pacific Ocean.

Flight Profile

The flight profile of a sounding rocket follows a parabolic trajectory—it goes up and comes back down. Flight time is less than 30 minutes.

Following launch, as a rocket motor uses its fuel it separates from the vehicle and falls back to Earth. The payload continues into space after separating from the motor(s) and begins conducting the experiment. When the experiment is completed, the payload reenters the atmosphere and a parachute is deployed, bringing the payload gently back to Earth. The payload is then retrieved. By retrieving the payload, a tremendous savings can be achieved because the payload or parts of the payload can be refurbished and flown again.

Preparing For the Future

Historically, sounding rocket missions have provided an excellent research opportunity for graduate students at the Master's and Doctorate level. In addition, high school and undergraduate students receive hands-on education through the NASA Student Involvement Program and the Student Launch Program. Both involve students in the full research process from experiment development through data analysis.

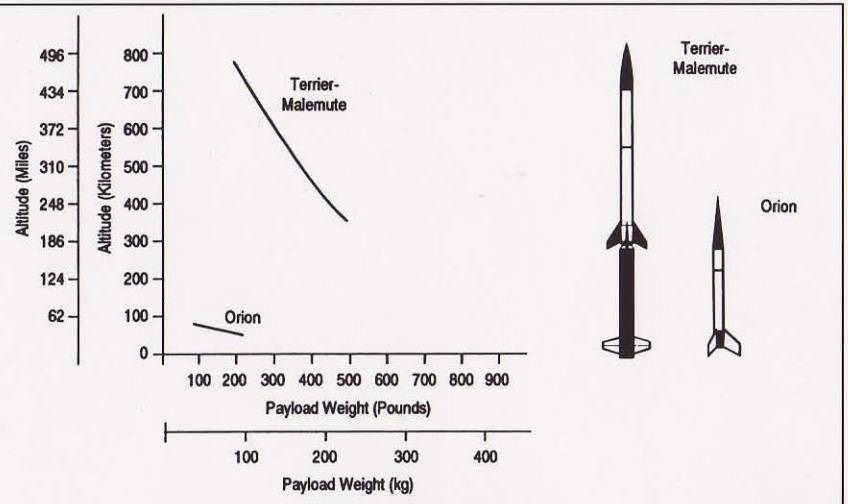
For the Classroom

1. Build and launch a model rocket. How does the flight profile compare to that of a sounding rocket?
2. Using the curve plotted on the sounding rocket performance chart, determine how high the sounding rocket can fly carrying the following payload weight.

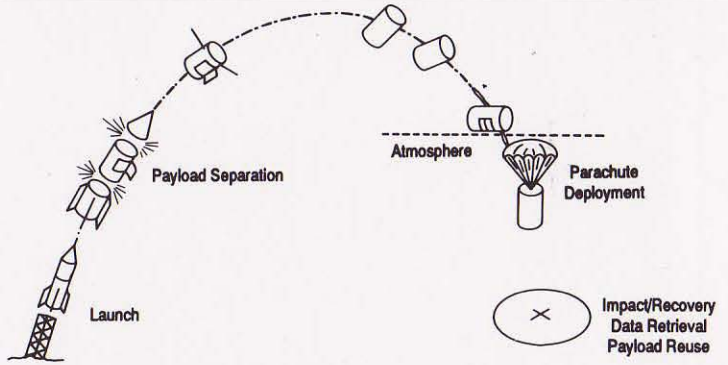
Orion	100 lbs. (45 kg),	200 lbs. (91 kg)
Terrier-Malemute	300 lbs. (136 kg),	400 lbs. (181 kg)

3. Research Newton's three laws of motion. How do they apply to rocketry?
4. Using the equation "distance = time (velocity)," solve the unknown for each sounding rocket. *(Note: 1 mile per second = 3,600 miles per hour)*

	Distance (altitude/miles)	Time (seconds)	Avg. Velocity (mph)
Orion	43 (86 km)	145	?



Sounding Rocket Performance



Sounding Rocket Mission Profile

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