National Aeronautics and Space Administration

Space Shuttle *Columbia* Lifts Off Into Space

Columbia, the first of NASA's Space Shuttle orbiters, lifted off into space on June 25, 1992, to begin the record-breaking 13 day STS-50 mission. Inside *Columbia's* payload bay was the cylindrical Spacelab, a pressurized laboratory for experiments. On this flight Spacelab was designated the U.S. Microgravity Laboratory. The experiments conducted by the seven astronauts and scientists onboard achieved important results in five basic areas: fluid dynamics, crystal growth, combustion science, biological science, and technology. This and subsequent flights help scientists to define and prepare for future space station operations.

This was *Columbia's* twelfth mission in space since it opened the Space Shuttle era on April 12, 1981. *Columbia's* first flight demonstrated the concept of a reusable spaceship: it flew into space as a rocket, orbited Earth as a spacecraft, and returned to Earth as a gliding airplane.

In this low-angle perspective view of the launch, *Columbia's* three main engines are clearly visible as a triangle of cones at the base of the orbiter immediately to the left of the vertical stabilizer. The engines are powered with a combination of liquid oxygen and liquid hydrogen. During flight, engine thrust ranges from a low of approximately 1.7 million newtons at sea level up to a high of approximately 2.3 million newtons in space vacuum. The exhaust of each engine appears faintly in the picture.

The silo-like brown external tank contains the propellants for the main engines. Most of the tank is hidden in this picture. The tank measures 47 meters long and 8.4 meters in diameter and is divided into two smaller tanks. The uppermost tank contains 542,640 liters of liquid oxygen while the lowermost tank contains 1,458,380 liters of liquid hydrogen. The two tanks provided enough propellants to power *Columbia's* main engines for approximately 8 minutes 30 seconds. When empty, the external tank is jettisoned and destroyed upon reentry into Earth's atmosphere.

Two smaller engines, seen flanking the vertical stabilizer, are the orbital maneuvering system engines. These engines are powered by a mixture of nitrogen tetroxide and monomethyl hydrazine contained in pods seen just above them in the picture. Upon jettisoning of the external tank, the engines are used to circularize the orbit. When it was time to return to Earth, these same engines were fired again, in the direction of the orbiter's motion, to slow the vehicle for its descent.

The greatest portion of the *Columbia's* liftoff thrust is supplied by two 45-meter-long and 3.7-meter-diameter solid rocket boosters. One of these boosters is seen attached to the external tank on the port side of *Columbia.* The starboard booster is hidden in this view. Burning a combination of solid chemicals, each booster produces a thrust of approximately 14,678,400 newtons. After burning for approximately two minutes, the boosters are jettisoned and land in the Atlantic Ocean by parachutes so that they may be recovered and reused later.

During the STS-50 mission, *Columbia* climbed to an altitude of 296 kilometers and made 221 orbits of Earth. By the time *Columbia* landed, it had traveled approximately 9,266,350 kilometers around Earth.

For the Classroom

1. How is the Space Shuttle different from other rockets such as the Saturn V and theTitan?

2. Obtain a plastic model of the Space Shuttle from a hobby shop. Assemble the model and rotate it in your hands until it is oriented in the same direction as the picture on the opposite side. Compare features on your model with those in the picture.

3. Why does the external tank carry a greater volume of liquid hydrogen than liquid oxygen? What is the waste product created when liquid hydrogen chemically combines with liquid oxygen to produce thrust for the main engines?