NARRATOR (Voice Over B-Roll): Millions of people watched the roaring engines, and thundering rush of fire and twin pillars of smoke that made up the unique signature of a space shuttle launch.

They saw four large machines work together precisely to send astronauts, satellites, observatories and space station sections into orbit.

The four elements, when combined ahead of a launch, were called a shuttle stack.

They included the shuttle itself, also known as the orbiter, plus a pair of solid rocket boosters and a single external fuel tank.

The external tank, or ET, is the familiar orange structure that dominates most images of the shuttle at liftoff.

At more than 15-stories tall, it is the largest single part of a shuttle stack.

It gets its signature orange color from the foam insulation sprayed on the tank's aluminum structure.

The insulation helps the tank act as a thermos bottle to keep the super cold propellants from evaporating too quickly.

It also helps prevent ice from forming on the tank's exterior and promotes the right aerodynamic shape for launching into space.

The main job of the tank is to hold about 535,000 gallons of super cold liquid hydrogen and liquid oxygen.

The lower portion of the tank holds the liquid hydrogen, which is the fuel for the engines.
The second-coldest known chemical, it is stored in the tank at minus 423 degrees Fahrenheit.

The upper part of the tank holds liquid oxygen, chilled to minus 297 degrees.

During the space shuttle fleet's 30 years of operation, the tank, like the shuttle itself, has undergone numerous upgrades and weight-saving improvements.

For example, designers quickly saved six hundred pounds by not painting the tank white after the first two missions.

Following a few revisions to designs and materials, the latest version of the tank, known as the Super Lightweight tank, is 17,000 pounds lighter than the first one Columbia used in 1981.

The tank also received extra attention after 2003's Columbia accident, which was blamed in part on a piece of the insulating foam on the tank breaking off, striking the left wing and creating a hole in the shuttle's heat shield.

Engineers implemented changes to the foam and the way it is applied and refined before the next launch.

Some foam was removed altogether to eliminate risk further.

The twin solid rocket boosters, or SRBs, are bolted to either side of the tank, with the shuttle itself riding piggyback.

This approach was revolutionary in rocket design when it debuted in 1981.
Until then, rockets were built by stacking one stage on the top of another and then casting off the stages one at a time until a small spacecraft was left on its own in orbit.

Until the space shuttle's first mission in 1981, no astronaut had ridden into orbit on the strength of a solid-fueled rocket.

The SRBs hold their own fuel, a mixture of powdered aluminum and a chemical called ammonium perchlorate.

When dry, the combination feels like a pencil eraser. The fuel is the "solid" in the solid rocket booster's name.

The 15-story-tall boosters work much simpler than liquid-fueled rockets that require complex engines and pumps.

They produce nearly 7 million pounds of thrust.

The solid rocket boosters do not ignite until the shuttle's main engines are up and running.

At liftoff, flames shoot down through the inside of the booster to ignite the fuel.

Once ignited, the boosters cannot be turned off. A pair of boosters combines to burn nine tons of fuel every second.

The boosters accelerate the 4.5 million-pound shuttle stack to 3,000 miles per hour and 24 miles high in two minutes.

By then, most of the fuel is used up and the boosters fall away, leaving the shuttle's own main engines to reach orbit.

The boosters parachute safely into the ocean where they're recovered and reused on later launches.
After the shuttle engines shut down and the orbiter is on its way,

the external tank falls away and safely burns up in the atmosphere over the ocean.

NASA's shuttle fleet performed unprecedented work in orbit during its career, whether deploying spacecraft to distant worlds,

setting up the Hubble Space Telescope to view the edge of the universe or building the largest orbiting laboratory in history.

Getting into space to perform that historic work took teamwork with the machinery of a shuttle stack.