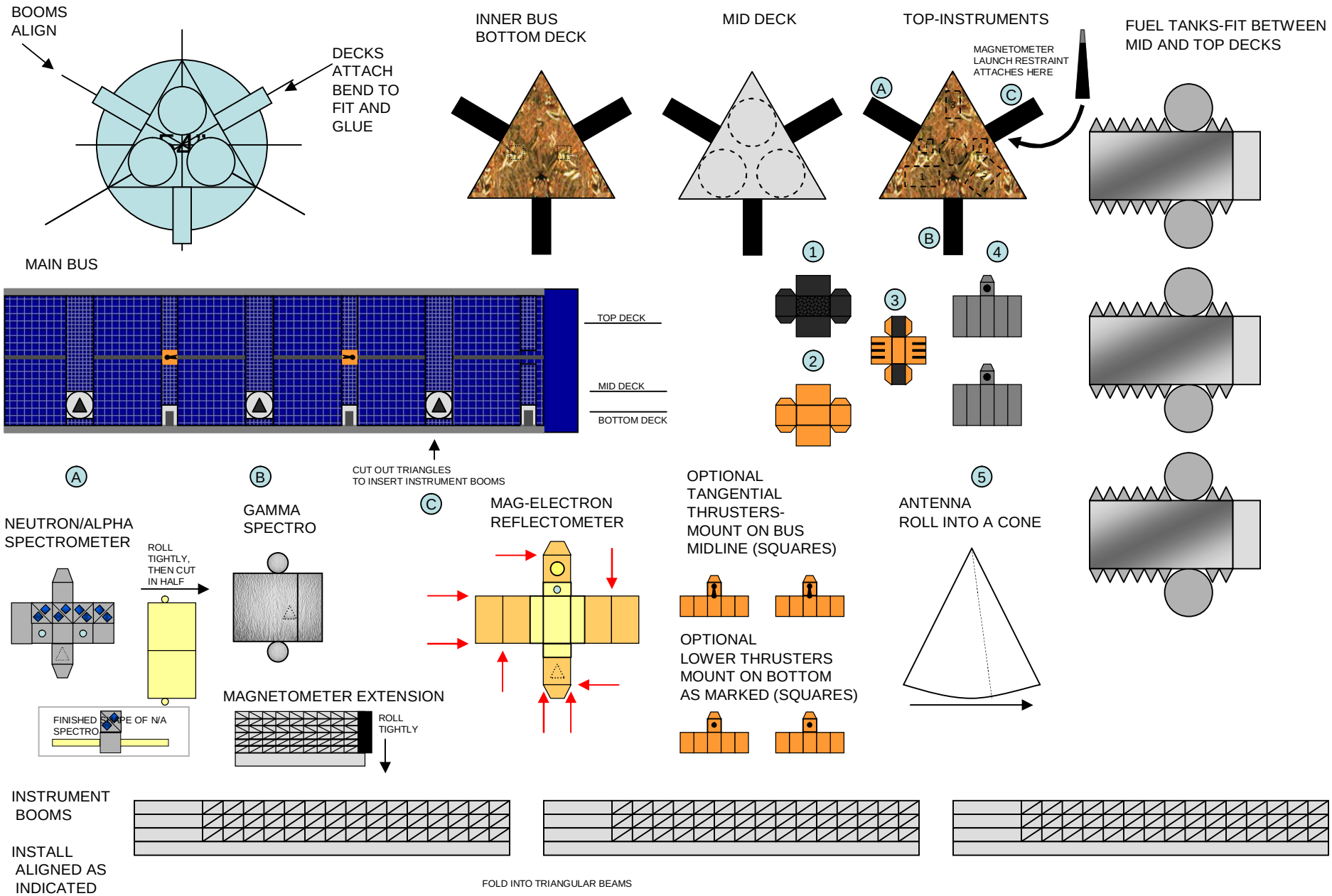
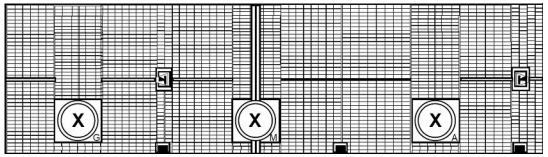
Lunar Prospector 1:48 scale

- The spacecraft is a graphite-epoxy **drum**, 1.37 meters (54”) in diameter and 1.28 (50”) meters high with three radial 2.5 m (98”) instrument booms. A 1.1 m (43”) extension boom at the end of one of the 2.5 m booms holds the magnetometer. Total initial mass (fully fueled) was 296 kg. It is spin-stabilized (nominal spin rate 12 rpm) with its spin axis normal to the ecliptic plane. The spacecraft is controlled by 6 hydrazine monopropellant 22-Newton thrusters, two aft, two forward, and two tangential. **Three fuel tanks** mounted inside the drum hold 138 kg of hydrazine pressurized by helium. The power system consists of body mounted solar cells which produce an average of 186 W and a 4.8 amp-hr rechargeable NiCd battery. Communications are through two S-band transponders, a slotted, phased-array medium gain antenna for downlink, and an omnidirectional low-gain antenna for downlink and uplink. There is no on-board computer, all control is from the ground, commanding a single on-board command and data handling unit. Data are downlinked directly and also stored on a solid-state recorder and downlinked after 53 minutes, to ensure all data collected during communications blackout periods are received.

- Assembly – score fold lines and cut out the parts. Cut out the triangles on the main bus where the instrument arms insert.
- Main bus – color the back of the main bus part black, then roll into a cylinder and glue. Place the bus cylinder over the bottom deck and mark where the attachment arms need to bend to fit inside. Prebend the mid and upper deck attach arms also. Bend the ends of the attachment arms toward the printed side. Insert the bottom deck into the main bus cylinder (printed side out) and glue with the deck surface level with the bottoms of the triangular cutouts. The bottom deck’s attachment arms align with the cutouts.
- Instrument Arms – fold/glue the instrument arms into triangular beams. Tightly roll the magnetometer extension boom into a thin cylinder and glue. Fold and glue up the instruments. Short arms attach to the circles on the sides of the neutron/alpha spectrometer. Magnetometer boom attaches to the small circle on the end of the mag/electron reflectometer box. Insert the instrument arms into the main bus through the triangular cut outs then glue to the bottom deck ensuring they are straight and even. Attach the instruments to the ends of the arms using the dotted triangles for reference, referring to page 3 for details. Note the markings A, B, and C to indicate instrument position around the main bus and the orientation of the top instrument deck.
- Fuel Tanks and upper decks – Roll/glue fuel tank cylinders then fold down and glue the ends to hold their shape. Glue the fuel tanks between the mid and upper decks – aligning the decks’ triangular shapes (colored sides of decks go up). Insert the assembly into the main bus, aligning it with the bottom deck and glue in place. The mid deck can seat on the instrument arms in lieu of trying to glue its attachment tabs to the cylinder.
- Upper Deck – assemble the equipment boxes and thrusters, then attach to the top deck in the locations marked. Carefully roll the antenna into a slender cone and trim the bottom if necessary to ensure it sits straight. Glue in place as marked. Glue the magnetometer arm launch restraint arm in place from the base of the attachment arm to the upper edge of the bus cylinder.
- Additional thrusters – if desired, assemble and attach the tangential thrusters to the dotted outlines on the mid line of the main bus, trimming the bottom edge to match the cylinder. Markings on the top (indicating a nozzle) go parallel to the circumference and in opposite directions – see the illustration on page 3 for detail. Similarly, attach the aft thrusters to the bottom deck.



The Lunar Prospector Spacecraft



Lunar Prospector circles the Moon in a polar orbit 100 km above the lunar surface. Traveling about 5,500 km/hour, the craft completes one full trip around the Moon every two hours. Due to the Moon's 28-day rotation, the lunar surface drifts about 26km between each orbit, measured at the equator. Over time, this permits Prospector to collect data from the entire lunar surface. The polar regions shift very little below Prospector's polar orbit.

The Electron Reflectometer is a remote sensing instrument which measures solar electrons reflected from local surface magenetic fields. Combined mass of the Magnetometer and Electron Reflectometer is about 5 kilograms. Together, the two instruments use 4.5 watts of power, and produce 670 bits of data per second.

Communications antennas Low-gain (top) and medium-gain antennas mounted here receive commands and frequencey reference signals "up" from Earth, and provide science data back "down" to Earth via NASA's Deep Space Network.

The Doppler Gravity Experiment uses the communications system to improve current models of the Moon's gravitational field. It does this by measuring minute variations in the spacecraft's speed. The Moon has more anomalies in its gravitational field than the Earth does; the crust is thicker on the far side of the Moon.

The Magnetometer is a direct-sensing instrument which measures magnetic fields in the vicinity of the spacecraft. Its location at the end of a boom helps isolate it from the magnetic fields generated by the spacecraft's own electronics.

This arm supported the Magnetometer during launch.

Horizon sensor provides input for attitude control and guidance.

Sun sensors provide input for attitude control.

Extendable Booms support the science instruments at a distance from the spacecraft, to provide unobstructed "views," and reduce interference from onboard systems. The booms are made of fiberglass, and were coiled inside cannisters in the spacecraft before launch.

Thrusters are used for attitude and spin control, and to make small orbital adjustments.

The Neutron Spectrometer detects "cool" neutrons: those that have bounced off hydrogen atoms on the lunar surface, providing evidence of water. The instrument's mass is 3.9 kilograms; it consumes 2.5 watts of power and produces 49 bits of data per second.

The Gamma Ray Spectrometer maps abundances of ten elements on the Moon's surface: thorium, potassium, uranium, iron, oxygen, silicon, aluminum, calcium, magnesium, and titanium. The instrument's mass is 8.6 kilograms; it uses 3 watts of power, and produces data at a rate of 688 bits per second.

Solar Panel consists of thousands of interconnected photovoltaic cells on a cylindrical shape. They convert sunlight directly into electricity to power the spacecraft's systems. The panel also offers shade for thermal control.

The Alpha Particle Spectrometer detects alpha particles emitted by radioactive gases, such as radon and polonium, leaking out of the lunar interior. The instrument's mass is 4 kilograms; it consumes 7 watts of power and produces data at a rate of 181 bits per second.

Assembled Lunar Prospector Space Craft™ SCIENCE KIT depicted.

Alternate inner bus replaces fuel tanks and upper & mid decks.

Cut out black rectangles to form upper attachment arms, leaving the arms attached to the top deck. Measure and bend arms to fit within main bus cylinder.

Bend down side panels, leaving attachment arms straight, and secure to bottom panel to form a triangular prism.

Install in main bus cylinder by gluing the bottom to the installed inner ends of the instrument arms and gluing the attachment arms to the inside of the cylinder near the top.