National Aeronautics and Space Administration

INSTRUCTOR'S GUIDE

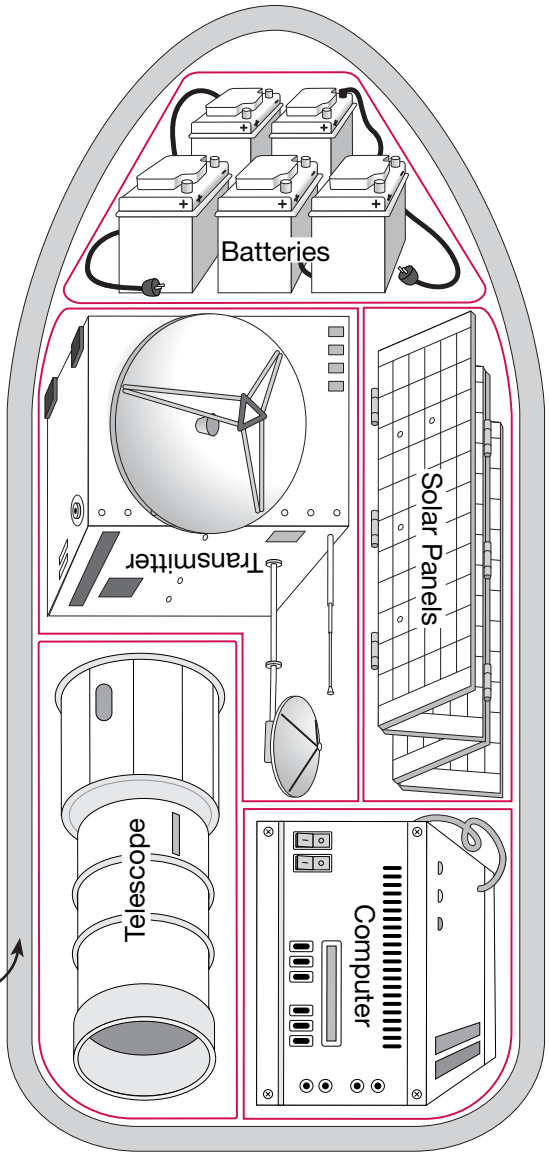
NASA Space Communications and Navigation

Packing a Rocket

GRADES K–3

Answer Key (several solutions are possible)

- **Telescopes** are tools that use special mirrors or lenses to look at things far away. In addition to having telescopes on the ground, NASA also sends telescopes into space where the atmosphere doesn't spoil their pictures. Some of NASA's famous telescopes are the Hubble Space Telescope, Spitzer Space Telescope, and the Chandra X-ray Observatory.
- **Solar panels** use electronics to change the Sun's energy into electricity, both on Earth and in space! This electricity is used to power the scientific instruments on the spacecraft. Solar panels are large and must be carefully folded up for launch.
- **Batteries** store the energy provided by solar panels, keeping it ready for when the spacecraft needs power. Sometimes spacecraft are in the shadow of a planet, where their solar panels can't make electricity. Batteries help spacecraft stay powered on until they are in sunlight again.
- All the data—pictures, measurements, and information about the spacecraft—need to be sent home from space for scientists to analyze. NASA uses **transmitters** to send data back to Earth. Most spacecraft use radio frequency transmitters, but new optical systems will be faster, smaller, and weigh less.
- Almost all spacecraft carry **computers** onboard to control the spacecraft. Computers are the spacecraft's brain. They come in many different shapes and sizes, but they all follow software programs, or special sets of instructions, to make decisions.
- Often, NASA must construct a shell, called a **fairing**, to fit over the spacecraft at the very tip of the rocket. The fairing protects the spacecraft during launch and keeps the rocket aerodynamic. Once the rocket has left the atmosphere, the fairing can be ejected, or jettisoned, and either discarded or, sometimes, recovered.



To see an example of how NASA folds spacecraft to fit inside rocket fairings, animations of the Tracking and Data Relay Satellite, known as TDRS-K, can be seen here: ***http://go.nasa.gov/TDRS-K_videos.*** For an animation of the James Webb Space Telescope (JWST) deployment, visit: ***http://go.nasa.gov/JWST_deployment***

Additional JWST educational activities and resources can be found at ***http://go.nasa.gov/JWST_educators_formal*** and ***http://go.nasa.gov/JWST_activities***.