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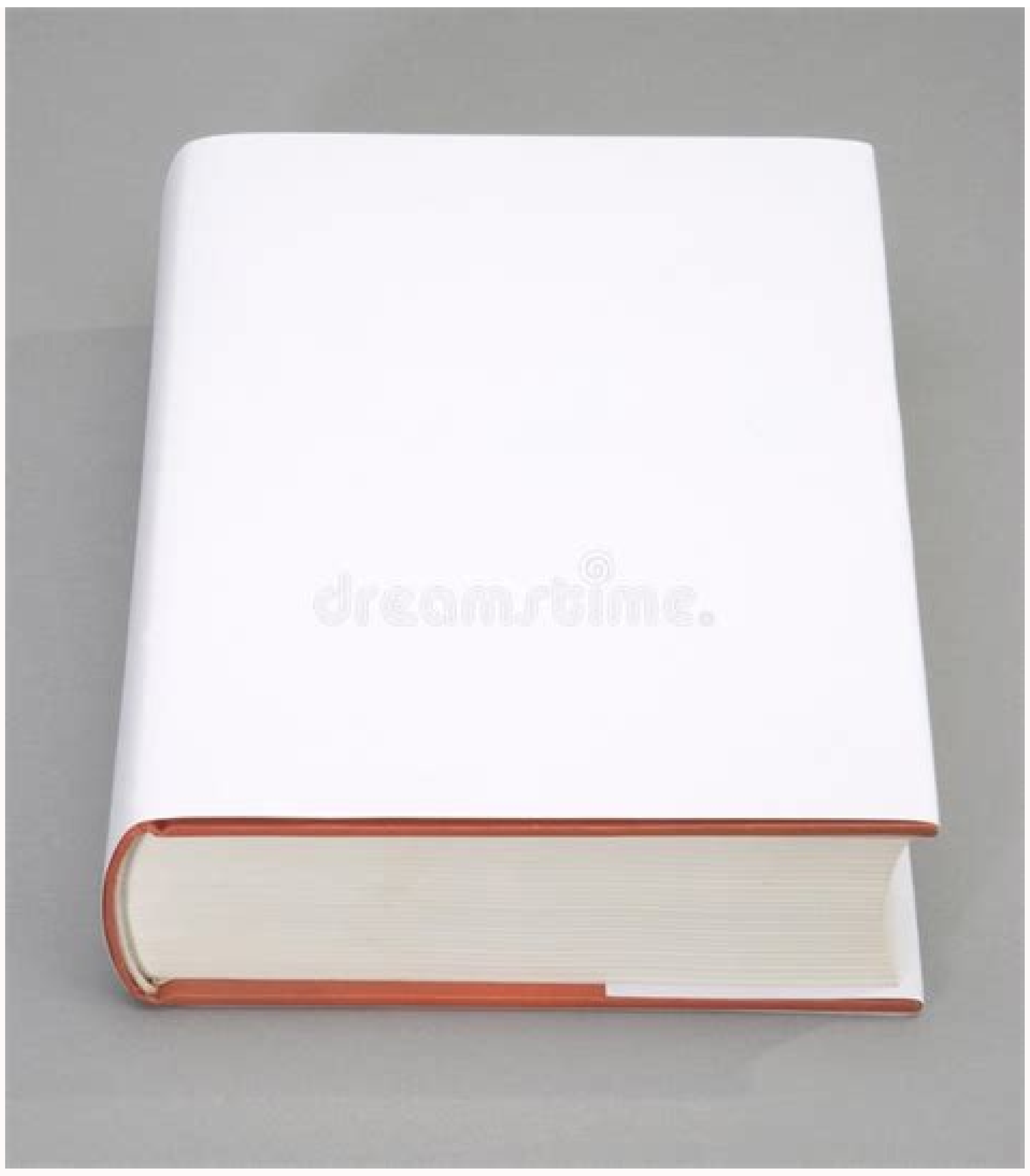
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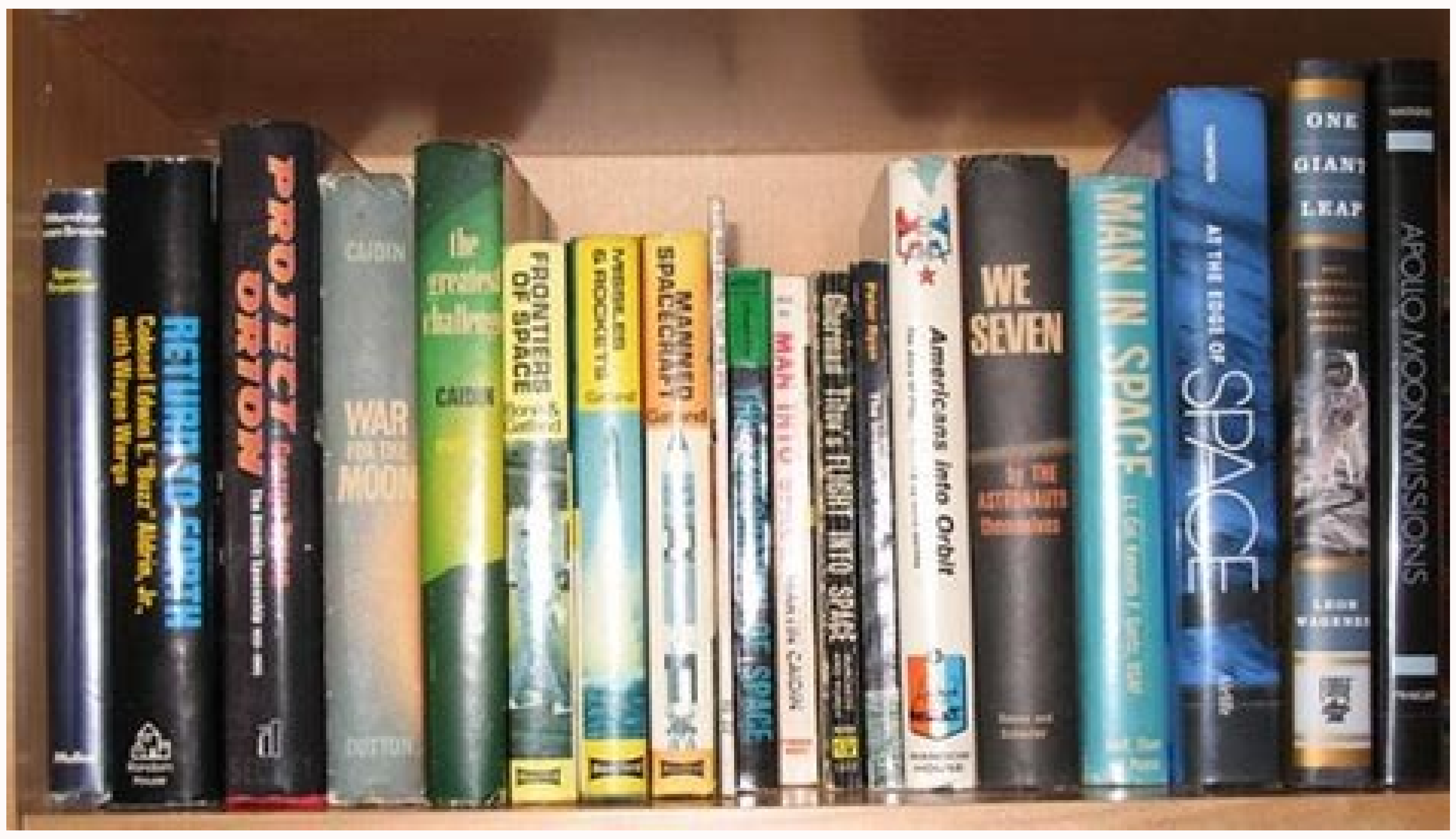
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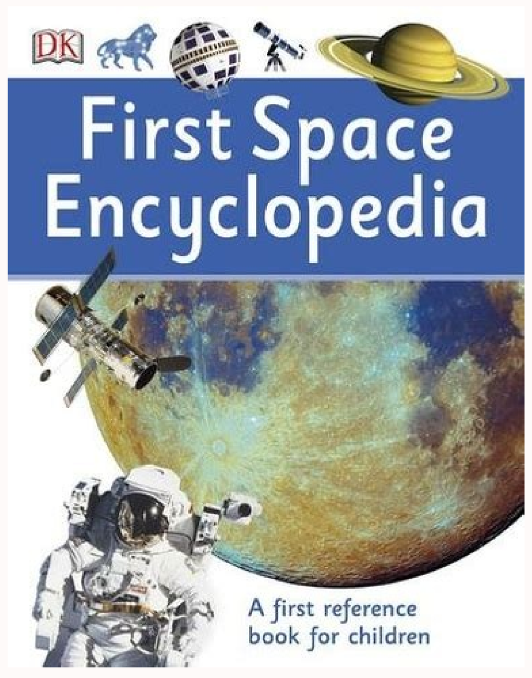
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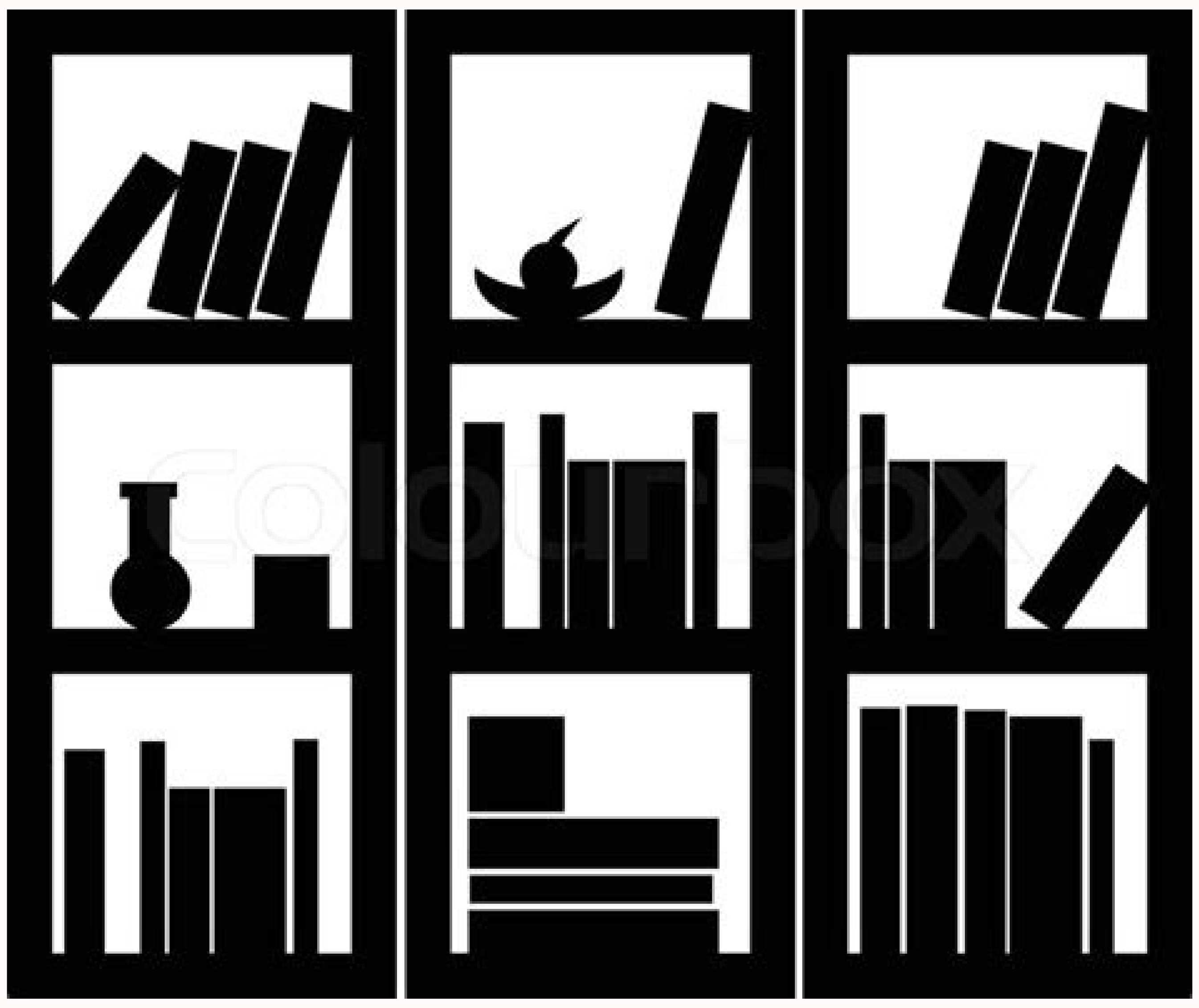

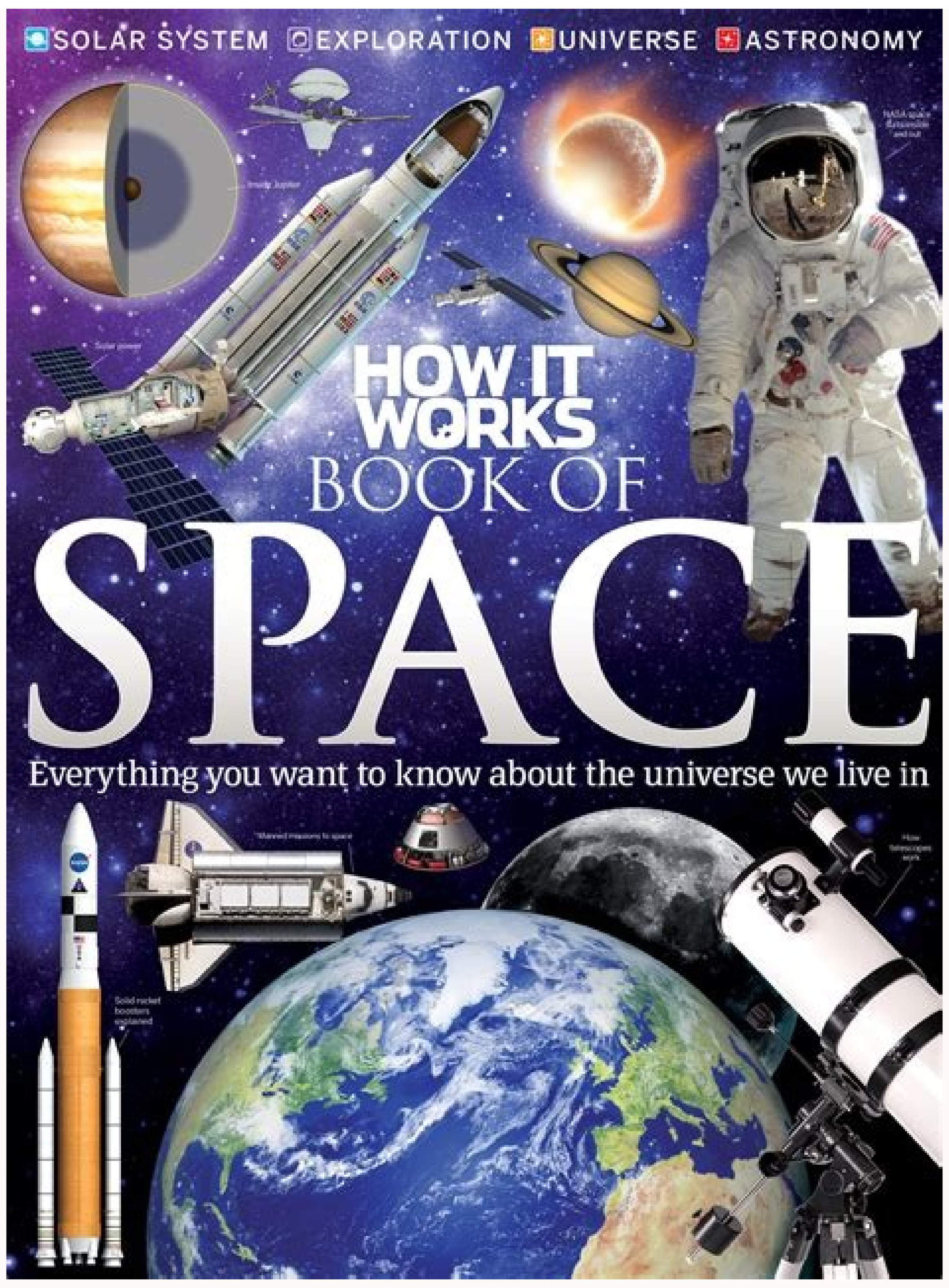

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No Text Content! 7 seconds TO THE LAUNCHPAD A 960-ton (870-metric-ton) launch table supports the launcher during assembly. The day before liftoff, a truck tows the launcher and table along rail tracks to the launchpad. Together, the truck and table weigh 1,650 tons (1,500 metric tons)—the equivalent of 1,500 cars. Propellant (fuel and oxidant) is piped into the launcher at the pad. ON THE LAUNCHPAD There are three trenches at the launch area through which flames from the boosters and main engine escape during liftoff. A tower supplies water at the rate of 1,000 cubic feet (30 cubic meters) per second during launch to reduce noise and to cool the trenches and launch table. Without the water, vibrations from the noise could damage the launcher and its payload. F IND OUT MORE H OW ROCKETS WORK 36 R OCKET PROPULSION 38 S PACE LAUNCHERS 40 L AUNCH CENTERS 42 A service unit on the launch table keeps Ariane 5 cool during its trip to the launchpad. LIFTOFF (c) 2011 Dorling Kindersley, Inc. All Rights Reserved. 46 A nything in orbit around another object can be called a satellite. The Moon, for example, is a natural satellite of Earth. Since 1957, hundreds of artificial satellites have been launched into orbit around Earth. They come in many shapes and sizes, and occupy different types of orbit, depending on what they are designed to do. Many communications satellites occupy geostationary orbit, for example, while many weather satellites are in polar orbit. Whichever orbit they follow, satellites must remain stable so that their instruments always point in the right directions. TYPES OF ORBIT Most satellites are launched into one of four orbits. A nearly circular low-Earth orbit is up to 155 miles (250 km) above Earth. Polar orbits are often 500 miles (800 km) high. An elliptical orbit has a much lower altitude at its closest approach to Earth (its perigee) than when it is most distant (its apogee). A geostationary orbit is 22,000 miles (36,000 km) above the equator. STABILIZING SATELLITES If a satellite is not stable—if it swings around in an unpredictable way—it cannot do its job. For example, the dish of a communications satellite must always point toward its receiving station, or toward the right country if it is transmitting television signals. Two techniques commonly used to maintain stability are spin and three-axis stabilization. TELEMETRY, TRACKING, AND COMMAND Telemetry—literally, measuring from far away— allows people on the ground to receive measurements from satellites in orbit. The measurements, sent as radio signals, might include information that allows operators to pinpoint the satellite's position. This allows people to track the satellite, and to send command signals that can change its position. Telemetry also includes data that allow ground controllers to check that the satellite is operating correctly. S ATELLITES AND ORBITS SPIN STABILIZATION Things that spin are naturally stable. A spinning top remains stable if it is spun fast enough, and the turning of its wheels helps to keep a bicycle upright. In the early days of satellites, designers decided to exploit this principle. The result is spin- stabilized satellites. These are often cylindrical in shape, and make about one revolution every second. The antenna dish must always point to Earth, so it does not spin. Designers must take care that the dish does not destabilize the satellite. Polar orbit Geostationary orbit Highly elliptical orbit Low-Earth orbit HS 376 SPIN-STABILIZED COMMUNICATIONS SATELLITE Antenna for telemetry and command Solar cell panels Antenna dish does not spin. Outer panels slip down in orbit to uncover solar panels beneath. This increases the power available to the satellite. Ground antenna sends and receives signals to and from the satellites. Antenna feed radiates radio signals that reflect off the dish. If sensors detect a wobble in the satellite, thrusters correct spin and restore stability. Equipment is designed to fit into the satellite's cylindrical shape. Scale exaggerated for clarity. EXPLORING SPACE (c) 2011 Dorling Kindersley, Inc. All Rights Reserved. Sensors detect slight wobbles and signal for the satellite's orientation to be corrected. 47 F IRST SATELLITES • The Soviet Sputnik 1 (launched October 4, 1957) was the first satellite. It sent no telemetry. • Explorer 1 (launched February 1, 1958) was the first US satellite. It found hints of the Van Allen radiation belts. • The US Explorer 7 (launched August 7, 1959) carried the first instruments to study climate. • The US Transit 1B (launched April 13, 1960) was the world's first navigation satellite. • The first weather satellite was US TIROS 1 (launched April 1, 1960). It sent pictures to Earth for two months. • Intelsat's Early Bird (launched April 6, 1965) was the first commercially operated communications satellite. OTHER STABILIZING METHODS The forces exerted on a satellite can be used to maintain stability in space. For example, large satellites can exploit gravity to align themselves so that their instruments always point to Earth. Others interact with Earth's magnetic field to gain stability. The method of stabilization depends on the job the satellite has to do and the orbit it occupies. SOLAR CELLS Solar cells produce electrical power when light falls on them. On satellites, the cells are arranged into solar panels, sometimes called arrays. They provide satellites with the power they need to do their job. In addition, the cells provide the power needed to keep the satellite and its payload in orbit. F IND OUT MORE S PACE LAUNCHERS 40 C OMMUNICATIONS SATELLITES 48 N AVIGATION SATELLITES 50 M ETEOROLOGY SATELLITES 52 E ARTH RESOURCES SATELLITES 54 M ILITARY SATELLITES 56 HOUSEKEEPING DATA Information about a satellite's health is called housekeeping data.These data alert ground control when something is wrong—if the satellite is becoming unstable, for instance. Ground-based operators can often send a command to solve the problem, or organize a rescue mission. HS 601 THREE-AXIS STABILIZED COMMUNICATIONS SATELLITE Three-axis stabilized satellites have a boxlike shape rather than cylindrical. Antenna always points to Earth. Mirrored panels reflect sunlight onto satellite platform for temperature control. Enlargement of solar cells in a panel Solar panels extend like wings and always face the Sun. W ESTAR SATELLITE RESCUE Satellite platform carries communications equipment. THREEAXIS STABILIZATION Three-axis stabilized satellites contain small spinning wheels that rotate in such a way that they always keep the satellite in the same orientation to the Earth and Sun. If the satellite's sensors detect a deviation on any of the three axes of the cube, a signal is sent to the wheels to spin faster or slower. These changes restore the satellite to its correct orientation. Space Shuttle astronaut retrieves the Westar satellite to bring it back to Earth for repair. In 1984, Westar 6's telemetry showed that the satellite had failed to reach its correct orbit after launch. USING SPACE S ATELLITE ORBITAL DATA Orbit Typical payload Low-Earth Mobile communications, reconnaissance Geostationary Weather, communications, navigation Polar Weather, navigation Highly elliptical Communications at northern latitudes (c) 2011 Dorling Kindersley, Inc. All Rights Reserved. 48 COMMUNICATIONS LINK Antennas on the ground and on satellites send and receive radio waves that carry telephone calls, television signals, or data. A telephone call from Europe to the US, for example, might pass through the public telephone network to a nearby Earth station, which transmits the radio waves to a satellite in GEO. The satellite would then amplify and retransmit the radio waves to an antenna in the US, where the signal is routed over the telephone network to its destination. T elephone calls, television broadcasts, and the internet can all be relayed by communications satellites. These satellites connect distant places and make communication possible with remote areas. Many are in geostationary orbit (GEO), but so great is the demand for communications that this orbit has become crowded. Since the 1990s, fleets of satellites have been launched into low-Earth orbit (below GEO) to carry signals for the growing number of cell phones. C OMMUNICATIONS SATELLITES GEOSTATIONARY SATELLITES Satellites in GEO above the equator always seem to stay over the same spot on Earth. They appear stationary because a satellite 22,000 miles (36,000 km) above Earth takes the same time to complete one orbit as Earth takes to spin on its axis. They remain in sight of the same Earth station. Antennas transmit and receive signals. They are key to an Earth station's operation, regardless of whether the station is on land, sea, or in the air. Science fiction author Arthur C. Clarke first suggested GEO for communications satellites in 1945. Three satellites, spaced evenly apart in GEO, can view the entire planet, except the polar regions. C OMMUNICATIONS SATELLITE TRANSPONDERS Devices called transponders are at the heart of communications satellites. They contain a chain of electronic components. These components clean up radio signals, which can be distorted after traveling through the atmosphere, and convert them to the frequency necessary for transmission back to Earth. They also amplify the signals before retransmitting them. C OMMUNICATIONS SATELLITE TRANSPONDER SATELLITE FOOTPRINT Just as the beams of spotlights have different shapes and sizes, so radio waves transmitted by a satellite fall on Earth with a particular pattern. This pattern is known as the satellite footprint. Antennas within the footprint can transmit and receive signals to and from the satellite. EARTH STATIONS The antennas and other equipment needed on the ground to transmit and receive signals to and from satellites are known as the Earth station. Earth stations can be housed in large buildings. Their antennas act as a gateway through which, for example, thousands of telephone calls are transmitted to and from a satellite. Earth stations can also be small units, designed to fit on ships or planes. Satellite footprint might cover a whole continent or one small country. Thanks to communications satellites, telephone calls are possible between plane and ground. Radio signals lose strength as they travel through space. EXPLORING SPACE (c) 2011 Dorling Kindersley, Inc. All Rights Reserved.

Encyclopedia.com – Online dictionary and encyclopedia with pictures, facts, and videos. Get information and homework help with millions of articles in our FREE, online library. A comprehensive suite of e-learning resources designed for all ages and abilities with articles, videos, educator tools, eBooks, research guides and more. A vacuum is a space devoid of matter.The word is derived from the Latin adjective vacuus for "vacant" or "void".An approximation to such vacuum is a region with a gaseous pressure much less than atmospheric pressure. Physicists often discuss ideal test results that would occur in a perfect vacuum, which they sometimes simply call "vacuum" or free space, and use the term ...

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