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The Atmosphere and Climate of Mars - Robert M. Haberle
2017-06-29

Humanity has long been fascinated by the planet Mars. Was its climate ever conducive to life? What is the atmosphere like today and why did it change so dramatically over time? Eleven spacecraft have successfully flown to Mars since the Viking mission of the 1970s and early 1980s. These orbiters, landers and rovers have generated vast amounts of data that now span a Martian decade (roughly eighteen years). This new volume brings together the many new ideas about the atmosphere and climate system that have emerged, including the complex interplay of the volatile and dust cycles, the atmosphere-surface interactions that connect them over time, and the diversity of the planet's environment and its complex history. Including tutorials and explanations of complicated ideas, students, researchers and non-specialists alike are able to use this resource to gain a thorough and up-to-date understanding of this most Earth-like of planetary neighbours.

Ceres: An Ice-rich World In The Inner Solar System - Jian-yang Li
2022-01-17

Thanks to NASA's Dawn mission, the last half-decade has witnessed a significant advance in our understanding of Ceres. The largest object between the orbits of Mars and Jupiter, Ceres is the most water-rich body in the inner solar system after Earth which shows evidence of brine-driven activity in its recent history, and even possibly at the present. The potential existence of a subsurface ocean or regional seas in Ceres and its salt- and organic-rich composition underscore its astro-biological significance. After signaling the discovery of the asteroid belt more than two centuries ago, Ceres once again reveals new insights for us to understand the formation, evolution, and habitability of this large icy body in our solar system. This book reviews the current state of knowledge about Ceres after the extensive scientific exploration by the Dawn mission. Starting from the introduction of the discovery of Ceres and what we know about this enigmatic world before Dawn's arrival, each chapter focuses on one aspect of Ceres, including its surface composition, its geology, the role of water ice in shaping Ceres's surface, its interior structure, and expressions of cryovolcanic or brine activity at the surface. Following this framework, the book addresses the astro-biological significance of Ceres. The last chapter summarizes the new questions opened by the Dawn mission and the next step to exploring the dwarf planet closest to Earth.

The Martian Surface - Jim Bell 2008-06-05

Phenomenal new observations from Earth-based telescopes and Mars-based orbiters, landers, and rovers have dramatically advanced our understanding of the past environments on Mars. These include the first global-scale infrared and reflectance spectroscopic maps of the surface, leading to the discovery of key minerals indicative of specific past climate conditions; the discovery of large reservoirs of subsurface water ice; and the detailed in situ roving investigations of three new landing sites. This an important, new overview of the compositional and mineralogic properties of Mars since the last major study published in 1992. An exciting resource for all researchers and students in planetary science, astronomy, space exploration, planetary geology, and planetary geochemistry where specialized terms are explained to be easily understood by all who are just entering the field.

Discovering Mars - William Sheehan 2021-11-09

A leading historian of astronomy and a leading planetary scientist who works at the forefront of space exploration provide a comprehensive history of the solar system's most alluring planet beyond Earth. William Sheehan and Jim Bell chronicle how ancient watchers of the skies attended to Mars's red color and baffling movements, how three and a half centuries of telescopic observations added vistas and controversies around possible seas and continents and canals, and how the current era of exploration by flyby, orbiter, lander, and rover spacecraft have

conjured for us the reality of a world of towering shield volcanoes, vast canyons, ancient dry riverbeds--and even possible evidence of past life. A unique collaboration between two authors on the forefront of Mars explorations, past and future, *Discovering Mars* provides an ambitious, detailed, and evocative account of humanity's enduring fascination with the Red Planet.

Promoting Productive Cooperation Between Space Lawyers and Engineers - Nakarada Pecujlic, Anja 2019-03-29

A major non-technical challenge of space activities is ensuring productive cooperation, communication, and understanding between the engineers who design the mission and the space lawyers who cover its relevant legal aspects. Though both groups usually attain some level of understanding, it is only achieved after many years of experience in the space industry and through repeated contact with topics relevant to their projects. A basic understanding of the most important legal and technical aspects acquired earlier in their careers can facilitate better cooperation and more efficient development of space projects. *Promoting Productive Cooperation Between Space Lawyers and Engineers* is a pivotal reference source that provides vital insights into basic legal and technical topics and challenges that occur while planning and conducting typical space activities. The book uses high-profile space missions as examples and highlights the major technical aspects of these missions and the legal issues applied to these missions. While highlighting topics such as planetary settlements, policy perspectives, and suborbital spaceflight, this publication is ideally designed for lawyers, engineers, academicians, students, and professionals.

Chondrules - Sara S. Russell 2018-06-30

Chondrules are spherical silicate grains which formed from protoplanetary disk material, and as such provide an important record of the conditions of the Solar System in pre-planetary times. Chondrules are a major constituent in chondritic meteorites, however despite being recognised for over 200 years, their origins remain enigmatic. This comprehensive review describes state-of-the-art research into chondrules, bringing together leading cosmochemists and astrophysicists to review the properties of chondrules and their possible formation mechanisms based on careful observations of their chemistry, mineralogy, petrology and isotopic composition. Current and upcoming space missions returning material from chondritic asteroids and cometary bodies has invigorated research in this field, leading to new models and observations, and providing new insight into the conditions and timescales of the solar protoplanetary disk. Presenting the most recent advances, this book is an invaluable reference for researchers and graduate students interested in meteorites, asteroids, planetary accretion and solar system dynamics.

Observing the Solar System - Gerald North 2012-10-25

A practical primer for aspiring observers of the planets and other Solar System objects, written by an experienced amateur astronomer.

Meteorite Mineralogy - Alan Rubin 2021-02-28

Meteorites are fascinating cosmic visitors. Using accessible language, this book documents the history of mineralogy and meteorite research, summarizes the mineralogical characteristics of the myriad varieties of meteorites, and explains the mineralogical characteristics of Solar System bodies visited by spacecraft. Some of these bodies contain minerals that do not occur naturally on Earth or in meteorites. The book explains how to recognize different phases under the microscope and in back-scattered electron images. It summarizes the major ways in which meteoritic minerals form - from condensation in the expanding atmospheres of dying stars to crystallization in deep-seated magmas, from flash-melting in the solar nebula to weathering in the terrestrial environment. Containing spectacular back-scattered electron images, colour photographs of meteorite minerals, and with an accompanying online list of meteorite minerals, this book provides a useful resource for

meteorite researchers, terrestrial mineralogists, cosmochemists and planetary scientists, as well as graduate students in these fields

The Atlas of Mars - Kenneth S. Coles 2019-08-22

Planetary scientist and educator Ken Coles has teamed up with Ken Tanaka from the United States Geological Survey's Astrogeology team, and Phil Christensen, Principal Investigator of the Mars Odyssey orbiter's THEMIS science team, to produce this all-purpose reference atlas, *The Atlas of Mars*. Each of the thirty standard charts includes: a full-page color topographic map at 1:10,000,000 scale, a THEMIS daytime infrared map at the same scale with features labeled, a simplified geologic map of the corresponding area, and a section describing prominent features of interest. The Atlas is rounded out with extensive material on Mars' global characteristics, regional geography and geology, a glossary of terms, and an indexed gazetteer of up-to-date Martian feature names and nomenclature. This is an essential guide for a broad readership of academics, students, amateur astronomers, and space enthusiasts, replacing the NASA atlas from the 1970s.

Mars Sample Return - National Research Council 1997-03-28

The Space Studies Board of the National Research Council (NRC) serves as the primary adviser to the National Aeronautics and Space Administration (NASA) on planetary protection policy, the purpose of which is to preserve conditions for future biological and organic exploration of planets and other solar system objects and to protect Earth and its biosphere from potential extraterrestrial sources of contamination. In October 1995 the NRC received a letter from NASA requesting that the Space Studies Board examine and provide advice on planetary protection issues related to possible sample-return missions to near-Earth solar system bodies.

The Volcanoes of Mars - James R. Zimbelman 2020-12-05

The Volcanoes of Mars offers a clear, cohesive summary of Mars volcanology. It begins with an introduction to the geology and geography of the red planet and an overview of its volcanic history, and continues to discuss each distinct volcanic province, identifying the common and unique aspects of each region. Incorporating basic volcanological information and constraints on the regional geologic history derived from geologic mapping, the book also examines current constraints on the composition of the volcanic rocks as investigated by both orbiting spacecraft and rovers. In addition, it compares the features of Martian volcanoes to those seen on other volcanic bodies. Concluding with prospects for new knowledge to be gained from future Mars missions, this book brings researchers in volcanology and the study of Mars up to date on the latest findings in the study of volcanoes on Mars, allowing the reader to compare and contrast Martian volcanoes to volcanoes studied on Earth and throughout the Solar System. Presents clearly organized text and figures that will quickly allow the reader to find specific aspects of Martian volcanism. Includes definitions of geological and volcanological terms throughout to aid interdisciplinary understanding. Summarizes key results for each volcanic region of Mars and provides copious citations to the research literature to facilitate further discovery. Synthesizes the most current data from multiple spacecraft missions, including the Mars Reconnaissance Orbiter, as well as geochemical data from Martian meteorites. Utilizes published geologic mapping results to highlight the detailed knowledge that exists for each region.

Data Assimilation: Mathematical Concepts and Instructive Examples - Rodolfo Guzzi 2015-09-16

This book endeavours to give a concise contribution to understanding the data assimilation and related methodologies. The mathematical concepts and related algorithms are fully presented, especially for those facing this theme for the first time. The first chapter gives a wide overview of the data assimilation steps starting from Gauss' first methods to the most recent as those developed under the Monte Carlo methods. The second chapter treats the representation of the physical system as an ontological basis of the problem. The third chapter deals with the classical Kalman filter, while the fourth chapter deals with the advanced methods based on recursive Bayesian Estimation. A special chapter, the fifth, deals with the possible applications, from the first Lorenz model, passing through the biology and medicine up to planetary assimilation, mainly on Mars. This book serves both teachers and college students, and other interested parties providing the algorithms and formulas to manage the data assimilation everywhere a dynamic system is present.

Safe on Mars - National Research Council 2002-06-29

This study, commissioned by the National Aeronautics and Space Administration (NASA), examines the role of robotic exploration missions in assessing the risks to the first human missions to Mars. Only those

hazards arising from exposure to environmental, chemical, and biological agents on the planet are assessed. To ensure that it was including all previously identified hazards in its study, the Committee on Precursor Measurements Necessary to Support Human Operations on the Surface of Mars referred to the most recent report from NASA's Mars Exploration Program/ Payload Analysis Group (MEPAG) (Greeley, 2001). The committee concluded that the requirements identified in the present NRC report are indeed the only ones essential for NASA to pursue in order to mitigate potential hazards to the first human missions to Mars.

Mars - Nadine G. Barlow 2008

Textbook on Mars for graduate students and researchers, in geology, chemistry, atmospheric sciences, and astronomy.

Planet Mars - François Forget 2007-12-12

This book gives a new insight of Mars by adopting an original outline based on history rather than on subtopic (atmosphere, surface, interior). It focuses on the past and present evolution of Mars and also incorporates all the recent results from the space missions of Mars Express, Spirit and Opportunity. This book goes to the heart of current planetological research, and illustrates it with many beautiful images. The authors describe the magnificent scenery on Mars. The authors introduce a new world and reveal the workings of the planet Mars, and they describe current research to prepare for future missions to Mars.

Vision and Voyages for Planetary Science in the Decade 2013-2022 - National Research Council 2012-01-30

In recent years, planetary science has seen a tremendous growth in new knowledge. Deposits of water ice exist at the Moon's poles. Discoveries on the surface of Mars point to an early warm wet climate, and perhaps conditions under which life could have emerged. Liquid methane rain falls on Saturn's moon Titan, creating rivers, lakes, and geologic landscapes with uncanny resemblances to Earth's. *Vision and Voyages for Planetary Science in the Decade 2013-2022* surveys the current state of knowledge of the solar system and recommends a suite of planetary science flagship missions for the decade 2013-2022 that could provide a steady stream of important new discoveries about the solar system. Research priorities defined in the report were selected through a rigorous review that included input from five expert panels. NASA's highest priority large mission should be the Mars Astrobiology Explorer-Cacher (MAX-C), a mission to Mars that could help determine whether the planet ever supported life and could also help answer questions about its geologic and climatic history. Other projects should include a mission to Jupiter's icy moon Europa and its subsurface ocean, and the Uranus Orbiter and Probe mission to investigate that planet's interior structure, atmosphere, and composition. For medium-size missions, *Vision and Voyages for Planetary Science in the Decade 2013-2022* recommends that NASA select two new missions to be included in its New Frontiers program, which explores the solar system with frequent, mid-size spacecraft missions. If NASA cannot stay within budget for any of these proposed flagship projects, it should focus on smaller, less expensive missions first. *Vision and Voyages for Planetary Science in the Decade 2013-2022* suggests that the National Science Foundation expand its funding for existing laboratories and establish new facilities as needed. It also recommends that the program enlist the participation of international partners. This report is a vital resource for government agencies supporting space science, the planetary science community, and the public.

Vesta and Ceres - Simone Marchi 2022-03-31

A definitive reference on the Dawn mission and its results, covering the formation and evolution of the asteroid belt.

Mars: An Introduction to its Interior, Surface and Atmosphere - Nadine Barlow 2008-01-10

Our knowledge of Mars has changed dramatically in the past 40 years due to the wealth of information provided by Earth-based and orbiting telescopes, and spacecraft investigations. Recent observations suggest that water has played a major role in the climatic and geologic history of the planet. This textbook covers our understanding of the planet's formation, geology, atmosphere, interior, surface properties, and potential for life. This interdisciplinary textbook encompasses the fields of geology, chemistry, atmospheric sciences, geophysics, and astronomy. Each chapter introduces the necessary background information to help the non-specialist understand the topics explored. It includes results from missions through 2006, including the latest insights from Mars Express and the Mars Exploration Rovers. Containing the most up-to-date information on Mars, this textbook is essential reading for graduate courses, and an important reference for researchers.

Mars - A Warmer, Wetter Planet - Jeffrey S. Kargel 2004-07-23

Mars is the Solar System's other wild, wet, water world. Long believed to have become cold, dead, and dry aeons ago, we now having striking new proof, not only that Mars was a relatively warm and wet place in geologically recent times, but that even today there are vast reserves of water frozen beneath the planet's surface. This compelling new evidence may well boost the chances of a manned mission to Mars sooner, rather than later. The discovery is also forcing a complete rethink about the mechanisms of global planetary change. What does the drastic turn of events on Mars mean for Earth's climate system? Could life have thrived on Mars very recently, and might it survive today in short-term hibernation? Will humans soon be capable of living off the natural resources that Martian hydrogeology has naturally offered us? Will humans one day be capable of setting off the same chain of events that nature has repeatedly triggered to set off warm, wet episodes on Mars? How could Mars be terraformed into a New World? (And should we even contemplate doing so?) This book offers a visually beautiful, scientifically detailed and accurate presentation of the evidence that has forced this new revolution in Mars science. From the reviews: "Long believed to have been cold, dead and dry for eons, there is now striking new proof that not only was Mars a relatively warm and wet place in geologically recent times, but that even today there are vast reserves of water frozen beneath the planet's surface. In this absorbing, beautifully illustrated book, Kargel describes the still-unfolding revolution in our knowledge about the Red Planet and how future concepts of Mars will continue to be molded by new revelations of four billion years of geology". (LUNAR AND PLANETARY INFORMATION BULLETIN) From the reviews: "This exhaustive, effusive, and enthusiastic book conveys the excitement of frontline scientific research about as well as can be done. Kargel describes himself as a member of the "Tucson Mafia," a group of scientists in full rebellion against the "Mars Establishment" and its belief in a cold, dry Mars. His ideas are presented in meticulous detail, supported by hundreds of superb pictures, many taken by the author himself. Some--perhaps most--of his ideas are controversial and may ultimately prove to be wrong, as he himself often points out, but we have to applaud the (sometimes career-risking) courage with which he has pursued them. In spite of the large amount of rather technical information, the reader is swept along by the author's enthusiasm in conveying it and ability to integrate it into a coherent vision. The reader also learns about the process of science: the thrill of having a new idea and discussing it with others at conferences and cafes (and bars), the drudgery often involved in pursuing the idea, the perils of the formal review process for publications and grant applications, and the roles played by personality conflicts and power politics. Summing Up: Enthusiastically recommended. All levels. " (T. Barker, CHOICE, March 2005)

Introducing the Planets and their Moons - Peter Cattermole 2014-09-04

The solar system, of which Earth is but a small part, is an amazing collection of bodies, ranging in size from the Sun, through the giant planet Jupiter, to specks of dust left over from the primordial nebula from which the system emerged. Excluding the Sun, the eight major planets, together with several dwarf planets and at least 160 orbiting natural satellites, form the main mass of the system. These are made from an amalgam of silicate, metal, ice and gas. Peter Cattermole describes the characteristics and geological development of the eight large planetary bodies and their more substantial moons. This includes discussion of their orbital properties, magnetic fields, atmospheres and mutual interactions. Rather than deal with the system planet by planet, his approach is comparative. Thus one chapter deals with planetary orbits, another with planetary differentiation and a third with volcanism. This enables the reader to perceive immediately how their position and size led these bodies along different evolutionary paths. The book is copiously illustrated with some of the finest images available, lacks technical equations and terms, and includes a useful glossary for reference. By using this format, it follows other titles in the same series.

Mercury - Sean C. Solomon 2018-12-20

Observations from the first spacecraft to orbit the planet Mercury have transformed our understanding of the origin and evolution of rocky planets. This volume is the definitive resource about Mercury for planetary scientists, from students to senior researchers. Topics treated in depth include Mercury's chemical composition; the structure of its crust, lithosphere, mantle, and core; Mercury's modern and ancient magnetic field; Mercury's geology, including the planet's major geological units and their surface chemistry and mineralogy, its spectral reflectance characteristics, its craters and cratering history, its tectonic features and deformational history, its volcanic features and magmatic

history, its distinctive hollows, and the frozen ices in its polar deposits; Mercury's exosphere and magnetosphere and the processes that govern their dynamics and their interaction with the solar wind and interplanetary magnetic field; the formation and large-scale evolution of the planet; and current plans and needed capabilities to explore Mercury further in the future.

Assessment of Mars Science and Mission Priorities - National Research Council 2003-07-08

Within the Office of Space Science of the National Aeronautics and Space Administration (NASA) special importance is attached to exploration of the planet Mars, because it is the most like Earth of the planets in the solar system and the place where the first detection of extraterrestrial life seems most likely to be made. The failures in 1999 of two NASA missions-Mars Climate Orbiter and Mars Polar Lander-caused the space agency's program of Mars exploration to be systematically rethought, both technologically and scientifically. A new Mars Exploration Program plan (summarized in Appendix A) was announced in October 2000. The Committee on Planetary and Lunar Exploration (COMPLEX), a standing committee of the Space Studies Board of the National Research Council, was asked to examine the scientific content of this new program. This goals of this report are the following: -Review the state of knowledge of the planet Mars, with special emphasis on findings of the most recent Mars missions and related research activities; -Review the most important Mars research opportunities in the immediate future; -Review scientific priorities for the exploration of Mars identified by COMPLEX (and other scientific advisory groups) and their motivation, and consider the degree to which recent discoveries suggest a reordering of priorities; and -Assess the congruence between NASA's evolving Mars Exploration Program plan and these recommended priorities, and suggest any adjustments that might be warranted.

Mysteries of Mars - Fabio Vittorio De Blasio 2018-09-28

This book introduces the reader to the wonders of Mars, covering all aspects from our past perceptions of the planet through to the latest knowledge on its history, its surface processes such as impact cratering, volcano formation, and glaciation, and its atmosphere and climate. In addition, a series of ten intriguing open issues are considered in a more advanced way. These include such thought-provoking questions as What turned off the planet's magnetic field?, Why are the northern and southern hemispheres so different?, What was the fate of the once abundant water?, and Is there, or was there, life on Mars? Numerous original figures, unavailable elsewhere, reproduce details of images from Viking, CTX, MOC, HiRISE, THEMIS, and HRSC. The book will appeal especially to general readers interested in planetary sciences, astronomy, astrogeology, and space exploration and to students of Earth Sciences and Natural and Environmental Sciences. The higher-level material on the remaining mysteries of Mars will also be of interest to astrogeologists and other researchers.

Planetary Ring Systems - Matthew S. Tiscareno 2018-03-22

Planetary rings are among the most intriguing structures of our solar system and have fascinated generations of astronomers. Collating emerging knowledge in the field, this volume reviews our current understanding of ring systems with reference to the rings of Saturn, Uranus, Neptune, and more. Written by leading experts, the history of ring research and the basics of ring-particle orbits is followed by a review of the known planetary ring systems. All aspects of ring system science are described in detail, including specific dynamical processes, types of structures, thermal properties and their origins, and investigations using computer simulations and laboratory experiments. The concluding chapters discuss the prospects of future missions to planetary rings, the ways in which ring science informs and is informed by the study of other astrophysical disks, and a perspective on the field's future. Researchers of all levels will benefit from this thorough and engaging presentation.

Remote and Robotic Investigations of the Solar System - C.R. Kitchin 2017-09-18

Interest in and knowledge of the techniques utilised to investigate our solar system has been growing rapidly for decades and has now reached a stage of maturity. Therefore, the time has now arrived for a book that provides a cohesive and coherent account of how we have obtained our present knowledge of solar system objects, not including the Sun. Remote and Robotic Investigations of the Solar System covers all aspects of solar system observations: the instruments, their theory, and their practical use both on Earth and in space. It explores the state-of-the-art telescopes, cameras, spacecraft and instruments used to analyse the interiors, surfaces, atmospheres and radiation belts of solar system

objects, in addition to radio waves, gamma rays, cosmic rays and neutrinos. This book would be ideal for university students undertaking physical science subjects and professionals working in the field, in addition to amateur astronomers and anyone interested in learning more about our local astronomical neighbours.

Volatiles in the Martian Crust - Justin Filiberto 2018-08-30

Volatiles in the Martian Crust is a vital reference for future missions - including ESA's EXO Mars and NASA's Mars2020 rover - looking for evidence of life on Mars and the potential for habitability and human exploration of the Martian crust. Mars science is a rapidly evolving topic with new data returned from the planet on a daily basis. The book presents chapters written by well-established experts who currently focus on the topic, providing the reader with a fresh, up-to-date and accurate view. Organized into two main sections, the first half of the book focuses on the Martian meteorites and specific volatile elements. The second half of the book explores processes and locations on the crust, including what we have learned about volatile mobility in the Martian crust. Coverage includes data from orbiter and in situ rovers and landers, geochemical and geophysical modeling, and combined data from the SNC meteorites. Presents information about the nature, relationship, and reactivity of chemical elements and compounds on Mars Explores the potential habitability of Mars Provides a comprehensive view of volatiles in the Martian crust from studies of actual samples as well as from the variety of landed missions, including the MER and Curiosity rovers Delivers a vital reference for ongoing and future missions to Mars while synthesizing large data sets and research on volatiles in the Martian atmosphere Concludes with an informative summary chapter that looks to future Mars missions and what might be learned

Planetary Surface Processes - H. Jay Melosh 2011-08-25

Planetary Surface Processes is the first advanced textbook to cover the full range of geologic processes that shape the surfaces of planetary-scale bodies. Using a modern, quantitative approach, this book reconsiders geologic processes outside the traditional terrestrial context. It highlights processes that are contingent upon Earth's unique circumstances and processes that are universal. For example, it shows explicitly that equations predicting the velocity of a river are dependent on gravity: traditional geomorphology textbooks fail to take this into account. This textbook is a one-stop source of information on planetary surface processes, providing readers with the necessary background to interpret new data from NASA, ESA and other space missions. Based on a course taught by the author at the University of Arizona for 25 years, it is aimed at advanced students, and is also an invaluable resource for researchers, professional planetary scientists and space-mission engineers.

Planetesimals - Linda T. Elkins-Tanton 2017-01-26

Processes governing the evolution of planetesimals are critical to understanding how rocky planets are formed, how water is delivered to them, the origin of planetary atmospheres, how cores and magnetic dynamos develop, and ultimately, which planets have the potential to be habitable. Theoretical advances and new data from asteroid and meteorite observations, coupled with spacecraft missions such as Rosetta and Dawn, have led to major advances in this field over the last decade. This transdisciplinary volume presents an authoritative overview of the latest in our understanding of the processes of planet formation. Combining meteorite, asteroid and icy body observations with theory and modelling of accretion and orbital dynamics, this text also provides insights into the exoplanetary system and the search for habitable worlds. This is an essential reference for those interested in planetary formation, solar system dynamics, exoplanets and planetary habitability.

A Traveler's Guide to Mars - William K. Hartmann 2003-01-01

Utilizes a travel guide format to bring together recent scientific discoveries about Mars, describing such features as its dry riverbeds, huge volcano, possible ancient sea floor, and impact craters.

Mars Exploration - Giuseppe Pezzella 2020-09-09

More than 50 years after the Mariner 4 flyby on 15 July 1965, Mars still represents the next frontier of space explorations. Of particular focus nowadays is crewed missions to the red planet. Over three sections, this book explores missions to Mars, in situ operations, and human-rated missions. Chapters address elements of design and possible psychological effects related to human-rated missions. The information contained herein will allow for the development of safe and efficient exploration missions to Mars.

Saturn in the 21st Century - Kevin H. Baines 2018-12-06

A detailed overview of Saturn's formation, evolution and structure written by eminent planetary scientists involved in the Cassini Orbiter

mission.

Titan - Ingo Müller-Wodarg 2014-02-24

"Although Titan is similar in terms of mass and size to Jupiter's moons, Ganymede and Callisto, it is the only one harboring a massive atmosphere. Moreover, unlike the Jovian system populated with four large moons, Titan is the only large moon around Saturn. The other Saturnian moons are much smaller and have an average density at least 25% less than Titan's uncompressed density and much below the density expected for a Solar composition (Johnson and Lunine, 2005), although with a large variation from satellite to satellite. Both Jupiter's and Saturn's moon systems are thought to have formed in a disk around the growing giant planet. However, the difference in architecture between the two systems probably reflects different disk characteristics and evolution (e.g. Sasaki et al., 2010), and in the case of Saturn, possibly the catastrophic loss of one or more Titan-sized moons (Canup, 2010).

Moreover, the presence of a massive atmosphere on Titan as well as the emission of gases from Enceladus' active south polar region (Waite et al., 2009) suggest that the primordial building blocks that comprise the Saturnian system were probably more volatile-rich than Jupiter's"--

Encyclopedia of the Solar System - Tilman Spohn 2014-05-30

The Encyclopedia of the Solar System, Third Edition—winner of the 2015 PROSE Award in Cosmology & Astronomy from the Association of American Publishers—provides a framework for understanding the origin and evolution of the solar system, historical discoveries, and details about planetary bodies and how they interact—with an astounding breadth of content and breathtaking visual impact. The encyclopedia includes the latest explorations and observations, hundreds of color digital images and illustrations, and over 1,000 pages. It stands alone as the definitive work in this field, and will serve as a modern messenger of scientific discovery and provide a look into the future of our solar system. New additions to the third edition reflect the latest progress and growth in the field, including past and present space missions to the terrestrial planets, the outer solar systems and space telescopes used to detect extrasolar planets. Winner of the 2015 PROSE Award in Cosmology & Astronomy from the Association of American Publishers Presents 700 full-color digital images and diagrams from current space missions and observatories, bringing to life the content and aiding in the understanding and retention of key concepts. Includes a substantial appendix containing data on planetary missions, fundamental data of relevance for planets and satellites, and a glossary, providing immediately accessible mission data for ease of use in conducting further research or for use in presentations and instruction. Contains an extensive bibliography, providing a guide for deeper studies into broader aspects of the field and serving as an excellent entry point for graduate students aiming to broaden their study of planetary science.

Experiments in Reduced Gravity - Nikolaus Kuhn 2014-09-06

Experiments in Reduced Gravity: Sediment Settling on Mars is the first book to be published that reflects experiments conducted on Martian geomorphology in reduced gravity. This brief yet important book on sediment experiments assesses the theoretical and empirical foundation of the models used to analyze the increasing information we have on the past geography on Mars. The book also evaluates the need to develop new methods for analyzing new information by providing a conceptual outline and a case study on how experiments can be used to test current theoretical considerations. The conceptual approach to identifying the need for and role of experiments will be of interest to planetary scientists and geoscientists not necessarily involved with Mars, but those using experiments in their research who can apply the book's concepts. Includes figures, diagrams, illustrations, and photographs to vividly explore experiments and outcomes in reduced gravity Provides an outline of planned experiments and questions related to Martian geomorphology Features results from the MarsSedEx 1 Experiment in 2012

Red Rover - Roger Wiens 2013-03-12

The principle investigator for the ChemCam instrument on the Curiosity rover and a scientist at Los Alamos National Laboratory, Wiens traces the ups and downs of the new era of robotic space exploration through his own experience working on some of the important projects over the past decade. His topics include from Minnesota to the moon, vindication, ticket to Mars, on the Rover, and seven minutes of terror. His account provides a framework for the images and data currently coming back from Curiosity.

The Geology of the Terrestrial Planets - R. Stephen Saunders 1984

Planetary Geoscience - Harry Y. McSween, Jr 2019-07-11

The ideal textbook resource to support a one-semester capstone course

in planetary processes for geoscience undergraduates.

Enceladus and the Icy Moons of Saturn - Paul M. Schenk 2018-11-27

With active geysers coating its surface with dazzlingly bright ice crystals, Saturn's large moon Enceladus is one of the most enigmatic worlds in our solar system. Underlying this activity are numerous further discoveries by the Cassini spacecraft, tantalizing us with evidence that Enceladus harbors a subsurface ocean of liquid water. Enceladus is thus newly realized as a forefront candidate among potentially habitable ocean worlds in our own solar system, although it is only one of a family of icy moons orbiting the giant ringed planet, each with its own story. As a new volume in the Space Science Series, Enceladus and the Icy Moons of Saturn brings together nearly eighty of the world's top experts writing more than twenty chapters to set the foundation for what we currently understand, while building the framework for the highest-priority questions to be addressed through ongoing spacecraft exploration. Topics include the physics and processes driving the geologic and geophysical phenomena of icy worlds, including, but not limited to, ring-moon interactions, interior melting due to tidal heating, ejection and reaccretion of vapor and particulates, ice tectonics, and cryovolcanism. By contextualizing each topic within the profusion of puzzles beckoning from among Saturn's many dozen moons, Enceladus and the Icy Moons of Saturn synthesizes planetary processes on a broad scale to inform and

propel both seasoned researchers and students toward achieving new advances in the coming decade and beyond.

The Science of Astrobiology - Julian Chela-Flores 2011-07-28

Since the publication of The New Science of Astrobiology in the year 2001—the first edition of the present book—two significant events have taken place raising the subject from the beginning of the present century to its present maturity. Firstly, in 2001 the Galileo Mission still had two years to complete its task, which turned out to be an outstanding survey of the Jovian system, especially of its intriguing satellite Europa. Secondly, the Cassini Huygens Mission was still on its way to Saturn. Its present success has surpassed all expectations of ESA and NASA. Astrobiologists still did not know that Titan was the fifth body in the Solar System that possibly contained a water ocean (including the Earth and the three Galilean satellites other than Io). For these reasons the book includes overviews of the evolutionary and molecular biology that are necessary. There is a discussion of other sectors of culture that are the natural frontiers of astrobiology, especially the humanities.

The Atmosphere and Climate of Mars - Robert M. Haberle
2017-06-29

This volume reviews all aspects of Mars atmospheric science from the surface to space, and from now and into the past.