

File Type PDF Lecture Tutorial  
For Introductory Astronomy

Answers

***Lecture Tutorial For  
Introductory Astronomy  
Answers***

*Influenced by astronomy  
education research, 21st*

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*Century Astronomy offers a complete pedagogical and media package that facilitates learning by doing, while the new one-column design makes the Fifth Edition the most accessible introductory text available*

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today.

*This book explores evidence-based practice in college science teaching. It is grounded in disciplinary education research by practicing scientists who have chosen to take*

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*Wieman's (2014) challenge seriously, and to investigate claims about the efficacy of alternative strategies in college science teaching. In editing this book, we have chosen to showcase outstanding cases of*

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*exemplary practice supported by solid evidence, and to include practitioners who offer models of teaching and learning that meet the high standards of the scientific disciplines. Our intention is to let these*

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*distinguished scientists speak for themselves and to offer authentic guidance to those who seek models of excellence. Our primary audience consists of the thousands of dedicated faculty and graduate students*

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## Answers

*who teach undergraduate science at community and technical colleges, 4-year liberal arts institutions, comprehensive regional campuses, and flagship research universities. In keeping with Wieman's challenge, our*

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*primary focus has been on identifying classroom practices that encourage and support meaningful learning and conceptual understanding in the natural sciences. The content is structured as follows: after an*



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*Introduction based on  
Constructivist Learning Theory  
(Section I), the practices we  
explore are Eliciting Ideas and  
Encouraging Reflection (Section  
II); Using Clickers to Engage  
Students (Section III);*

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*Supporting Peer Interaction  
through Small Group Activities  
(Section IV); Restructuring  
Curriculum and Instruction  
(Section V); Rethinking the  
Physical Environment (Section  
VI); Enhancing Understanding*

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*with Technology (Section VII),  
and Assessing Understanding  
(Section VIII). The book's final  
section (IX) is devoted to  
Professional Issues facing  
college and university faculty  
who choose to adopt active*

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*learning in their courses. The common feature underlying all of the strategies described in this book is their emphasis on actively engaging students who seek to make sense of natural objects and events. Many of the*

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*strategies we highlight emerge from a constructivist view of learning that has gained widespread acceptance in recent years. In this view, learners make sense of the world by forging connections*

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*between new ideas and those that are part of their existing knowledge base. For most students, that knowledge base is riddled with a host of naïve notions, misconceptions and alternative conceptions they*

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*have acquired throughout their lives. To a considerable extent, the job of the teacher is to coax out these ideas; to help students understand how their ideas differ from the scientifically accepted view; to*

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*assist as students restructure and reconcile their newly acquired knowledge; and to provide opportunities for students to evaluate what they have learned and apply it in novel circumstances. Clearly,*



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*this prescription demands far more than most college and university scientists have been prepared for.*

*A contemporary and complete introduction to astrophysics for astronomy and physics majors*

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*taking a two-semester survey course.*

*"Lecture-Tutorials for Introductory Astronomy," which was developed by the Conceptual Astronomy and Physics Education Research*

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*(CAPER) Team, is a collection of classroom-tested activities designed for the large-lecture introductory astronomy class, although it is suitable for any astronomy class. The Lecture-Tutorials are short, structured*

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*activities designed for students to complete while working in pairs. Each activity targets one or more specific learning objectives based on research on student difficulties in astronomy. Most activities can*

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## Answers

*be completed in 10 to 15 minutes. The instructor's guide provides, for each activity, the recommended prerequisite knowledge, the learning goals for the activity, a pre-activity assessment question, an answer*

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Answers

*key, suggestions for implementation, and follow-up questions to be used for class discussion or homework.*

*Bayesian Data Analysis, Third Edition*

*Lecture Tutorials in Introductory*

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*Geoscience*

*Evidence Based Instruction for  
Introductory Courses. Volume 1*

*A Primer on Scientific*

*Programming with Python*

Astronomy is a popular subject for

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non-science majors in the United States, often representing a last formal exposure to science. Research has demonstrated the efficacy of active learning, but college astronomy instructors are often unaware of the tools and methods they can use to increase student



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comprehension and engagement. This book focuses on practical implementation of evidence-based strategies that are supported by research literature. Chapter topics include an overview of learner-centered theories and strategies for course design and implementation,

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## Answers

the use of Lecture-Tutorials, the use of technology and simulations to support learner-centered teaching, the use of research-based projects, citizen science, World Wide Telescope and planetariums in instruction, an overview of assessment, considerations for

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teaching at a community college, and strategies to increase the inclusivity of courses.

Army: Explorations-An Introduction to Astronomy, 6th edition, is built on the foundation of its well known writing style, accuracy, and emphasis on current information. This new

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edition continues to offer the most complete technology/new media support package available. That technology/new media package includes: Interactives, Animations, and introducing Connect - online homework and course management. With Astronomy Today, Eighth

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Edition, trusted authors Eric Chaisson and Steve McMillan communicate their excitement about astronomy, delivering current and thorough science with insightful pedagogy. The text emphasizes critical thinking and visualization, and it focuses on the process of

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scientific discovery, teaching students how we know what we know. Alternate Versions \*Astronomy Today, Volume 1: The Solar System, Eighth Edition-Focuses primarily on planetary coverage for a 1-term course. Includes Chapters 1-16, 28. \*Astronomy Today, Volume 2: Stars

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## Answers

and Galaxies, Eighth Edition-Focuses primarily on stars and stellar evolution for a 1-term course.

Includes Chapters 1-5 and 16-28.

This book features Ranking Task exercises - an innovative type of conceptual exercise that challenges readers to make comparative

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judgments about a set of variations on a particular physical situation. Two-hundred-and-eighteen exercises encourage readers to formulate their own ideas about the behavior of a physical system, correct any misconceptions they may have, and build a better conceptual foundation



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of physics. Covering as many topic domains in physics as possible, the book contains Kinematics Ranking Tasks, Force Ranking Tasks, Projectile and Other Two-Dimensional Motion Ranking Tasks, Work-Energy Ranking Tasks, Impulse-Momentum Ranking Tasks, Rotation

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## Answers

Ranking Tasks, SHM and Properties of Matter Ranking Tasks, Heat and Thermodynamics Ranking Tasks, Electrostatics Ranking Tasks, DC Circuit Ranking Tasks, Magnetism and Electromagnetism Ranking Tasks, and Wave and Optics Ranking Tasks. For anyone who wants a

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## Answers

better conceptual understanding of  
the many areas of physics.

The Solar System

21st Century Astronomy

Lecture Tutorials for Introductory

Geoscience

I Clicker 2 Student Remote

A Bayesian Tutorial

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The National Science Foundation funded a synthesis study on the status, contributions, and future direction of discipline-based education research (DBER) in physics, biological sciences,

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geosciences, and chemistry.  
DBER combines knowledge of teaching and learning with deep knowledge of discipline-specific science content. It describes the discipline-specific difficulties learners face and the

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specialized intellectual and instructional resources that can facilitate student understanding. Discipline-Based Education Research is based on a 30-month study built on two workshops held in 2008 to

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explore evidence on promising practices in undergraduate science, technology, engineering, and mathematics (STEM) education. This book asks questions that are essential to advancing DBER

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and broadening its impact on undergraduate science teaching and learning. The book provides empirical research on undergraduate teaching and learning in the sciences, explores the extent to which



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this research currently influences undergraduate instruction, and identifies the intellectual and material resources required to further develop DBER. Discipline-Based Education Research provides

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guidance for future DBER research. In addition, the findings and recommendations of this report may invite, if not assist, post-secondary institutions to increase interest and research activity in DBER

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and improve its quality and usefulness across all natural science disciplines, as well as guide instruction and assessment across natural science courses to improve student learning. The book

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brings greater focus to issues of student attrition in the natural sciences that are related to the quality of instruction. Discipline-Based Education Research will be of interest to educators, policy makers, researchers,

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scholars, decision makers in universities, government agencies, curriculum developers, research sponsors, and education advocacy groups. This fully revised and updated text is a comprehensive

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introduction to astronomical objects and phenomena. By applying some basic physical principles to a variety of situations, students will learn how to relate everyday physics to the astronomical world.

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Starting with the simplest objects, the text contains explanations of how and why astronomical phenomena occur, and how astronomers collect and interpret information about stars, galaxies and the solar

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system. The text looks at the properties of stars, star formation and evolution; neutron stars and black holes; the nature of galaxies; and the structure of the universe. It examines the past, present and



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future states of the universe;  
and final chapters use the  
concepts that have been  
developed to study the solar  
system, its formation; the  
possibility of finding other  
planetary systems; and the

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search for extraterrestrial life.  
This comprehensive text  
contains useful equations,  
chapter summaries, worked  
examples and end-of-chapter  
problem sets.

Introduction to Astronomy &

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Cosmology is a modern undergraduate textbook, combining both the theory behind astronomy with the very latest developments. Written for science students, this book takes a carefully developed

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scientific approach to this dynamic subject. Every major concept is accompanied by a worked example with end of chapter problems to improve understanding Includes coverage of the very latest

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developments such as double pulsars and the dark galaxy. Beautifully illustrated in full colour throughout  
Supplementary web site with many additional full colour images, content, and latest

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developments.

Funded by the National Science Foundation, Lecture-Tutorials for Introductory Astronomy is designed to help make large lecture-format courses more interactive with easy-to-

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implement student activities that can be integrated into existing course structures. The Second Edition of the Lecture-Tutorials for Introductory Astronomy contains nine new activities that focus on

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## Answers

planetary science, system related topics, and the interactions of Light and matter. These new activities have been created using the same rigorous class-test development process that was used for the highly



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successful first edition. Each of the 38 Lecture-Tutorials, presented in a classroom-ready format, challenges students with a series of carefully designed questions that spark classroom discussion, engage

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students in critical reasoning,  
and require no equipment. The  
Night Sky: Position, Motion,  
Seasonal Stars, Solar vs.  
Sidereal Day, Ecliptic, Star  
Charts. Fundamentals of  
Astronomy: Kepler's 2nd Law,

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Answers

Kepler's 3rd Law, Newton's  
Laws and Gravity, Apparent and  
Absolute Magnitudes of Stars,  
The Parsec, Parallax and  
Distance, Spectroscopic  
Parallax. Nature of Light in  
Astronomy: The

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Answers

Electromagnetic (EM) Spectrum  
of Light, Telescopes and Earth's  
Atmosphere, Luminosity,  
Temperature and Size,  
Blackbody Radiation, Types of  
Spectra, Light and Atoms,  
Analyzing Spectra, Doppler

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Shift. Our Solar System: The Cause of Moon Phases, Predicting Moon Phases, Path of Sun, Seasons, Observing Retrograde Motion, Earth's Changing Surface, Temperature and Formation of Our Solar

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Answers

System, Sun Size. Stars  
Galaxies and Beyond: H-R  
Diagram, Star Formation and  
Lifetimes, Binary Stars, The  
Motion of Extrasolar Planets,  
Stellar Evolution, Milky Way  
Scales, Galaxy Classification,

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Looking at Distant Objects,  
Expansion of the Universe. For  
all readers interested in  
astronomy.

African Cultural Astronomy  
AN INTRODUCTION TO  
ASTROPHYSICS

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Ranking Task Exercises in  
Physics

Python Programming

Lecture Tutorials for  
Introductory Astronomy

*This best-selling textbook addresses  
the need for an introduction to*



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## Answers

*econometrics specifically written for  
finance students. Key features: •*

*Thoroughly revised and updated,  
including two new chapters on panel  
data and limited dependent variable  
models • Problem-solving approach  
assumes no prior knowledge of*

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## Answers

*econometrics emphasising intuition rather than formulae, giving students the skills and confidence to estimate and interpret models • Detailed examples and case studies from finance show students how techniques are applied in real research • Sample*

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Answers

*instructions and output from the popular computer package EViews enable students to implement models themselves and understand how to interpret results • Gives advice on planning and executing a project in empirical finance, preparing students*

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*for using econometrics in practice •  
Covers important modern topics such  
as time-series forecasting, volatility  
modelling, switching models and  
simulation methods • Thoroughly  
class-tested in leading finance  
schools. Bundle with EViews student*

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## Answers

*version 6 available. Please contact us  
for more details.*

*A set of brief worksheets designed to  
be completed by students working  
alone or in groups, Lecture Tutorials  
in Introductory Geoscience engage  
students in the learning process and*

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## Answers

*make abstract concepts real. Through the use of effective questioning, step-by-step learning, and a progression of simple-to-complex visuals, Lecture Tutorials help students construct correct scientific ideas about often-difficult topics, while dispelling*

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## Answers

*common misconceptions. Research based on extensive classroom use shows that Lecture Tutorials increase student learning more than just a lecture alone.*

*Get actively involved in the practical application of earth science concepts*

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Answers

*as you learn to navigate common  
pitfalls and misconceptions related to  
content from any introductory earth  
science course with Lecture Tutorials  
in Earth Science.*

*Now in its third edition, this classic  
book is widely considered the leading*



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## Answers

*text on Bayesian methods, lauded for its accessible, practical approach to analyzing data and solving research problems. Bayesian Data Analysis, Third Edition continues to take an applied approach to analysis using up-to-date Bayesian methods. The*

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## Answers

*authors—all leaders in the statistics community—introduce basic concepts from a data-analytic perspective before presenting advanced methods. Throughout the text, numerous worked examples drawn from real applications and research emphasize*

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*the use of Bayesian inference in practice. New to the Third Edition*  
*Four new chapters on nonparametric modeling Coverage of weakly informative priors and boundary-avoiding priors Updated discussion of cross-validation and predictive*

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*information criteria Improved  
convergence monitoring and effective  
sample size calculations for iterative  
simulation Presentations of  
Hamiltonian Monte Carlo, variational  
Bayes, and expectation propagation  
New and revised software code The*

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*book can be used in three different ways. For undergraduate students, it introduces Bayesian inference starting from first principles. For graduate students, the text presents effective current approaches to Bayesian modeling and computation in statistics*

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*and related fields. For researchers, it provides an assortment of Bayesian methods in applied statistics.*

*Additional materials, including data sets used in the examples, solutions to selected exercises, and software instructions, are available on the*

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*book's web page.*

*Astronomy Online*

*The Cosmic Perspective*

*Discipline-Based Education Research*

*An Introduction to Two-Dimensional*

*Quantum Field Theory with  $(0,2)$*

*Supersymmetry*

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*Lecture Tutorials for Earth Science*

***One of the strengths of this book is the author's ability to motivate the use of Bayesian methods through simple yet effective examples. - Katie St. Clair***



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**MAA Reviews.**

***Essential Radio Astronomy is  
the only textbook on the  
subject specifically designed  
for a one-semester  
introductory course for  
advanced undergraduates or***

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***graduate students in  
astronomy and astrophysics.  
It starts from first principles  
in order to fill gaps in  
students' backgrounds,  
make teaching easier for  
professors who are not***

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***expert radio astronomers,  
and provide a useful  
reference to the essential  
equations used by  
practitioners. This unique  
textbook reflects the fact  
that students of***

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***multiwavelength astronomy typically can afford to spend only one semester studying the observational techniques particular to each wavelength band. Essential Radio Astronomy presents***

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***only the most crucial concepts—succinctly and accessibly. It covers the general principles behind radio telescopes, receivers, and digital backends without getting bogged down in***

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***engineering details.***

***Emphasizing the physical processes in radio sources, the book's approach is shaped by the view that radio astrophysics owes more to thermodynamics***

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***than electromagnetism.***

***Proven in the classroom and  
generously illustrated  
throughout, Essential Radio  
Astronomy is an invaluable  
resource for students and  
researchers alike. The only***

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***textbook specifically  
designed for a one-semester  
course in radio astronomy  
Starts from first principles  
Makes teaching easier for  
astronomy professors who  
are not expert radio***

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***astronomers Emphasizes the  
physical processes in radio  
sources Covers the  
principles behind radio  
telescopes and receivers  
Provides the essential  
equations and fundamental***

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***constants used by  
practitioners Supplementary  
website includes lecture  
notes, problem sets, exams,  
and links to interactive  
demonstrations An online  
illustration package is***

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*available to professors*

*Lecture Tutorials for*

*Introductory*

*Astronomy Addison-Wesley*

*This book is suitable for use*

*in a university-level first*

*course in computing (CS1),*

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***as well as the increasingly popular course known as CS0. It is difficult for many students to master basic concepts in computer science and programming. A large portion of the***

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***confusion can be blamed on the complexity of the tools and materials that are traditionally used to teach CS1 and CS2. This textbook was written with a single overarching goal: to present***

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***the core concepts of  
computer science as simply  
as possible without being  
simplistic.***

***Foundations of Astrophysics  
Physics of Light and Optics  
(Black & White)***

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***Essential Radio Astronomy  
Tutorials in Introductory  
Physics  
Astronomy Education***

*This volume of lecture notes  
briefly introduces the basic  
concepts needed in any*

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*computational physics course:  
software and hardware,  
programming skills, linear  
algebra, and differential calculus.  
It then presents more advanced  
numerical methods to tackle the  
quantum many-body problem: it*



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*reviews the numerical renormalization group and then focuses on tensor network methods, from basic concepts to gauge invariant ones. Finally, in the last part, the author presents some applications of tensor*

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*network methods to equilibrium  
and out-of-equilibrium correlated  
quantum matter. The book can  
be used for a graduate  
computational physics course.  
After successfully completing  
such a course, a student should*

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*be able to write a tensor network program and can begin to explore the physics of many-body quantum systems. The book can also serve as a reference for researchers working or starting out in the*

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*field.*

*Astronomy is written in clear non-technical language, with the occasional touch of humor and a wide range of clarifying illustrations. It has many analogies drawn from everyday*

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*life to help non-science majors appreciate, on their own terms, what our modern exploration of the universe is revealing. The book can be used for either a one-semester or two-semester introductory course (bear in*

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*mind, you can customize your version and include only those chapters or sections you will be teaching.) It is made available free of charge in electronic form (and low cost in printed form) to students around the world. If you*

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*have ever thrown up your hands in despair over the spiraling cost of astronomy textbooks, you owe your students a good look at this one. Coverage and Scope Astronomy was written, updated, and reviewed by a broad range*

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*of astronomers and astronomy educators in a strong community effort. It is designed to meet scope and sequence requirements of introductory astronomy courses nationwide.*

*Chapter 1: Science and the*



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*Universe: A Brief Tour Chapter  
2: Observing the Sky: The Birth  
of Astronomy Chapter 3: Orbits  
and Gravity Chapter 4: Earth,  
Moon, and Sky Chapter 5:  
Radiation and Spectra Chapter  
6: Astronomical Instruments*

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*Chapter 7: Other Worlds: An  
Introduction to the Solar System*

*Chapter 8: Earth as a Planet*

*Chapter 9: Cratered Worlds*

*Chapter 10: Earthlike Planets:*

*Venus and Mars Chapter 11:*

*The Giant Planets Chapter 12:*

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*Rings, Moons, and Pluto Chapter  
13: Comets and Asteroids:  
Debris of the Solar System  
Chapter 14: Cosmic Samples  
and the Origin of the Solar  
System Chapter 15: The Sun: A  
Garden-Variety Star Chapter 16:*

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*The Sun: A Nuclear Powerhouse*  
*Chapter 17: Analyzing Starlight*  
*Chapter 18: The Stars: A*  
*Celestial Census Chapter 19:*  
*Celestial Distances Chapter 20:*  
*Between the Stars: Gas and*  
*Dust in Space Chapter 21: The*

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*Birth of Stars and the Discovery  
of Planets outside the Solar  
System Chapter 22: Stars from  
Adolescence to Old Age Chapter  
23: The Death of Stars Chapter  
24: Black Holes and Curved  
Spacetime Chapter 25: The*

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*Milky Way Galaxy Chapter 26:  
Galaxies Chapter 27: Active  
Galaxies, Quasars, and  
Supermassive Black Holes  
Chapter 28: The Evolution and  
Distribution of Galaxies Chapter  
29: The Big Bang Chapter 30:*

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*Life in the Universe Appendix A:  
How to Study for Your  
Introductory Astronomy Course  
Appendix B: Astronomy  
Websites, Pictures, and Apps  
Appendix C: Scientific Notation  
Appendix D: Units Used in*

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*Science Appendix E: Some  
Useful Constants for Astronomy  
Appendix F: Physical and Orbital  
Data for the Planets Appendix G:  
Selected Moons of the Planets  
Appendix H: Upcoming Total  
Eclipses Appendix I: The*



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*Nearest Stars, Brown Dwarfs,  
and White Dwarfs Appendix J:  
The Brightest Twenty Stars  
Appendix K: The Chemical  
Elements Appendix L: The  
Constellations Appendix M: Star  
Charts and Sky Event Resources*

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*Lecture-Tutorials for Introductory Astronomy provides a collection of 44 collaborative learning, inquiry-based activities to be used with introductory astronomy courses. Based on education research, these activities are*

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*“classroom ready” and lead to deeper, more complete understanding through a series of structured questions that prompt you to use reasoning and identify and correct their misconceptions. All content has*

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*been extensively field tested and six new tutorials have been added that respond to reviewer demand, numerous interviews, and nationally conducted workshops.*

*This is the first scholarly*

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*collection of articles focused on the cultural astronomy of the African continent. It weaves together astronomy, anthropology, and Africa and it includes African myths and legends about the sky,*

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*alignments to celestial bodies  
found at archaeological sites and  
at places of worship, rock art  
with celestial imagery, and  
scientific thinking revealed in  
local astronomy traditions  
including ethnomathematics and*

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*the creation of calendars.*

*The Universe at a Glance*

*Numerical simulations of low-  
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*Current Archaeoastronomy and  
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This book provides an introduction  
to Quantum Field Theory (QFT) at



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an elementary level—with only special relativity, electromagnetism and quantum mechanics as prerequisites. For this fresh approach to teaching QFT, based on numerous lectures and courses given by the authors, a

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representative sample of topics has been selected containing some of the more innovative, challenging or subtle concepts. They are presented with a minimum of technical details, the discussion of the main ideas being more

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important than the presentation of the typically very technical mathematical details necessary to obtain the final results. Special attention is given to the realization of symmetries in particle physics: global and local symmetries,

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explicit, spontaneously broken, and anomalous continuous symmetries, as well as discrete symmetries. Beyond providing an overview of the standard model of the strong, weak and electromagnetic interactions and the current

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understanding of the origin of mass, the text enumerates the general features of renormalization theory as well as providing a cursory description of effective field theories and the problem of naturalness in physics. Among the more advanced

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topics the reader will find are an outline of the first principles derivation of the CPT theorem and the spin-statistics connection. As indicated by the title, the main aim of this text is to motivate the reader to study QFT by providing a self-

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contained and approachable introduction to the most exciting and challenging aspects of this successful theoretical framework. This book introduces two-dimensional supersymmetric field theories with emphasis on both

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linear and non-linear sigma models. Complex differential geometry, in connection with supersymmetry, has played a key role in most developments of the last thirty years in quantum field theory and string theory. Both structures



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introduce a great deal of rigidity compared to the more general categories of non-supersymmetric theories and real differential geometry, allowing for many general conceptual results and detailed quantitative predictions.

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Two-dimensional  $(0,2)$  supersymmetric quantum field theories provide a natural arena for the fruitful interplay between geometry and quantum field theory. These theories play an important role in string theory and provide

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generalizations, still to be explored fully, of rich structures such as mirror symmetry. They also have applications to non-perturbative four-dimensional physics, for instance as descriptions of surface defects or low energy dynamics of

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solitonic strings in four-dimensional supersymmetric theories. The purpose of these lecture notes is to acquaint the reader with these fascinating theories, assuming a background in conformal theory, quantum field theory and differential

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geometry at the beginning graduate level. In order to investigate the profound relations between structures from complex geometry and field theory the text begins with a thorough examination of the basic structures of  $(0,2)$  quantum field

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theory and conformal field theory. Next, a simple class of Lagrangian theories, the (0,2) Landau-Ginzburg models, are discussed, together with the resulting renormalization group flows, dynamics, and symmetries. After a thorough

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introduction and examination of (0,2) non-linear sigma models, the text introduces linear sigma models that, in particular, provide a unified treatment of non-linear sigma models and Landau-Ginzburg theories. Many exercises, along

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with discussions of relevant mathematical notions and important open problems in the field, are included in the text.

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Choice, Vol. 47 (8), April 2010

Those of us who have learned scientific programming in Python ‘on the streets’ could be a little jealous of students who have the opportunity to take a course out of Langtangen’s Primer.” John D.

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Cook, The Mathematical  
Association of America, September  
2011 This book goes through  
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students new to scientific computing and would be the perfect bridge between an introduction to programming and an advanced course on numerical methods or computational science. Alex Small, IEEE, CiSE Vol. 14 (2), March /April

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