

## Lab 5 Star Spectra

**Vocabulary:** absorption spectrum, binary star, blueshift, Cepheid variable, emission spectrum, giant star, nebula, redshift, spectrum, star

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

1. What happens when light goes through a prism? It is bent, or refracted, by the angles and plane faces of the prism and each wavelength of light is refracted by a slightly different amount.

This band of colors is called a **spectrum**.

2. A rainbow is an example of a spectrum. What is the sequence of colors in a rainbow?

Red, orange, yellow, blue, indigo, violet

### Gizmo Warm-up

The interior of a **star** produces a continuous spectrum of light, like a rainbow. Cooler gases in the outer layers of the star absorb certain wavelengths of light, causing dark lines to appear in the spectrum. The resulting **absorption spectrum** can tell astronomers a great deal about the star.

1. On the *Star Spectra* Gizmo, turn on **Show labels**. Select **star 1** to see its absorption spectrum.

How many lines do you see in the spectrum? five



2. Drag the **Hydrogen** spectrum next to the **Star spectrum** so that the edges line up. Do some of the lines on the two spectra match up? Yes four lines on the spectrum do line up
3. Drag the **Helium** spectrum next to the **Star spectrum**. Do some lines match? Yes some do match
4. Try out the other available spectra. Do any others have lines that match? No
5. Which elements have contributed to the spectrum of **star 1**? Hydrogen and helium

*Note: The elements in a star's spectrum do not necessarily reflect what the star is made of. The absorption spectrum is mostly determined by the surface temperature of the star.*

# Answers For Virtual Astronomy Lab

**Karel van der Hucht**



## **Answers For Virtual Astronomy Lab:**

**Remote Instrumentation and Virtual Laboratories** Franco Davoli, Norbert Meyer, Roberto Pugliese, Sandro Zappatore, 2010-03-10 Accessing remote instrumentation worldwide is one of the goals of e Science The task of enabling the execution of complex experiments that involve the use of distributed scientific instruments must be supported by a number of different architectural domains which inter work in a coordinated fashion to provide the necessary functionality These domains embrace the physical instruments the communication network interconnecting the distributed systems the service oriented abstractions and their middleware The Grid paradigm or more generally the Service Oriented Architecture SOA viewed as a tool for the integration of distributed resources plays a significant role not only to manage computational aspects but increasingly as an aggregator of measurement instrumentation and pervasive large scale data acquisition platforms In this context the functionality of a SOA allows managing maintaining and exploiting heterogeneous instrumentation and acquisition devices in a unified way by providing standardized interfaces and common working environments to their users but the peculiar aspects of dealing with real instruments of widely different categories may add new functional requirements to this scenario On the other hand the growing transport capacity of core and access networks allows data transfer at unprecedented speed but new challenges arise from wireless access wireless sensor networks and the traversal of heterogeneous network domains The book focuses on all aspects related to the effective exploitation of remote instrumentation and to the building complex virtual laboratories on top of real devices and infrastructures These include SOA and related middleware high speed networking in support of Grid applications wireless Grids for acquisition devices and sensor networks Quality of Service QoS provisioning for real time control measurement instrumentation and methodology as well as metrology issues in distributed systems

**Highlights of Astronomy: Volume 14** Karel van der Hucht, 2008-01-21 Recording the proceedings of the IAU XXVI General Assembly this volume of the IAU Highlights of Astronomy covers virtually all aspects of modern astrophysics as discussed by 2400 participants from 73 countries Notably the common aspects of astrophysical phenomena known to exist in widely differing interstellar environments is thoroughly examined providing fertile cross correlation from one specialisation to another This text highlights the importance of the triennial IAU General Assemblies in bringing together the work of observers and theoreticians in widely different fields but working towards a common goal understanding the physics of the Universe Together with the Proceedings of the IAU Symposia 235 240 this volume examines all of the astrophysics presented at the General Assembly

[Organizations and Strategies in Astronomy](#) Andre Heck, 2012-12-06 We have arrived at the third volume of this useful series on Organizations and Strategies in Astronomy OSA It contains seventeen articles on a wide range of topics from virtual observatories astronomy organizations in various communities Czech Republic Slovak Republic South Africa and the role of ground stations in space observatories to quality assurance in UK higher education In this foreword I shall give some views on ideas expressed in this volume in

particular from my personal experience when I was project officer for the Canada France Hawaii Telescope CFHT Let me first remind readers that present and future astronomy is increasingly dependent on high level management Not everybody knows that the scheduling of the Hubble Space Telescope is performed by a neural network software called SPIKE described in the stimulating workshop New Observing Modes for the Next Century partly reported in OSA Volume II by 1 Robson New observing facilities in space or on the ground are so complex that they need highly qualified engineers and rigorous management procedures Each observing hour on the Very Large Telescope VLT facility is worth about EUR 7 000 including the amortization of the capital expenses over 30 years This does not leave much room for amateurism neither in the time allocation procedures nor in the daily telescope control

**The Solar System** Michael A. Seeds, 2007 Helps students use astronomy to understand science and use science to understand what we are Fascinating and engaging this text illustrates the scientific method and guides students to answer these fundamental questions What are we And how do we know

*Astronomy: The Human Quest for Understanding* Dale A. Ostlie, 2022-09-07 Since humans first looked up at the stars astronomy has had a particular ability to stir the imagination and challenge the thinking of scientists and non scientists alike Astronomy The Human Quest for Understanding is an introductory astronomy textbook specifically designed to relate to non science majors across a wide variety of disciplines nurture their curiosity and develop vital science based critical thinking skills This textbook provides an introduction to how science operates in practice and what makes it so successful in uncovering nature's secrets Given that the study of astronomy dates back thousands of years it is the ideal subject for tracing the development of the physical sciences and how our evolving understanding of nature has influenced and been influenced by mathematics philosophy religion geography politics and more This historical approach also illustrates how wrong turns have been taken and how the inherent self correcting nature of science through constant verification and the falsifiability of truly scientific theories ultimately leads us back to a more productive path in our quest for understanding This approach also points out why as a broadly educated citizenry students of all disciplines must understand how scientists arrive at conclusions and how science and technology have become central features of modern society In discussing this fascinating and beautiful universe of which we are a part it is necessary to illustrate the fundamental role that mathematics plays in decoding nature's mysteries Unlike other similar textbooks some basic mathematics is integrated naturally into the text together with interpretive language and supplemented with numerous examples additional tutorials are provided on the book's companion website Astronomy The Human Quest for Understanding leads the reader down the path to our present day understanding of our Solar System stars galaxies and the beginning and evolution of our universe along with profound questions still to be answered in this ancient yet rapidly changing field

**Learning Together Through Peer Instruction: A Comprehensive Guide for Astronomy Lecturers** Pasquale De Marco, 2025-04-16 In the ever evolving landscape of education peer instruction stands out as a transformative teaching method that actively engages students in the learning

process fostering deeper understanding and critical thinking skills This comprehensive guide provides astronomy lecturers with a wealth of resources and strategies to implement peer instruction effectively in their courses Discover the power of peer instruction and its benefits for both students and instructors Learn how to get started with peer instruction and overcome common challenges Delve into the art of crafting thought provoking conceptual questions that spark discussion and promote deeper learning Explore effective strategies for implementing peer instruction activities in the classroom both in traditional and online environments This book also addresses the importance of using technology to enhance peer instruction from online platforms and interactive tools to digital assessment and feedback mechanisms It provides guidance on assessing student learning through effective assessments and constructive feedback to help students grow and improve To foster a supportive and collaborative learning environment the book explores strategies for building a community of learners fostering collaboration and cooperation among students and creating a positive classroom climate It also discusses how to adapt peer instruction for diverse learning environments including large classes online and hybrid courses and students with disabilities Finally the book delves into evaluating the impact of peer instruction exploring research methods and best practices for measuring its effectiveness It also discusses the future of peer instruction and how it can continue to evolve to meet the changing needs of astronomy education With its comprehensive approach and wealth of practical advice this book is an essential resource for astronomy lecturers seeking to create dynamic and engaging learning experiences for their students Embrace peer instruction and inspire your students to explore the wonders of the universe with a deeper understanding and a passion for lifelong learning If you like this book write a review on google books     [Learning With Escape Rooms in Higher Education Online Environments](#) Santamaría Urbieta, Alexandra,Alcalde Peñalver, Elena,2023-02-10 Teachers professors and educational professionals have the opportunity to create new challenging significant and interactive learning experiences for today s students Escape rooms are growing in popularity as they provide numerous benefits and opportunities for learning however the use of escape rooms in higher education is not always taken seriously Learning With Escape Rooms in Higher Education Online Environments proves that it is possible to take escape rooms to higher education with great results for both teachers and students by presenting different escape room proposals that are explained in detail with the instructions and materials used so that any teacher could replicate it in their subject Covering key topics such as online learning student learning and computer science this reference work is ideal for principals industry professionals researchers scholars practitioners academicians instructors and students     *Development and Management of Virtual Schools* Catherine Cavanaugh,2004-01-01 Virtual schools are a result of widespread changes in knowledge about learning in available technology and in society Virtual schooling is growing in popularity and will continue to attract students because of the benefits it offers over traditional schooling Stakeholders in virtual schools need information to guide their decisions For the foreseeable future virtual schools will continue to meet diverse student needs and to evolve in response to further change

Development and Management of Virtual Schools Issues and Trends brings together knowledge of virtual schools as a reference for scholars and other groups involved in virtual schools The chapters review best practice from concept and development through implementation and evaluation     *Computer Support for Collaborative Learning* Gerry Stahl,2002  
Proceedings of CSCCL 2002 meeting in Boulder Colorado January 7 11 2002     *HCI International 2019 - Posters* Constantine Stephanidis,2019-07-10 The three volume set CCIS 1032 CCIS 1033 and CCIS 1034 contains the extended abstracts of the posters presented during the 21st International Conference on Human Computer Interaction HCII 2019 which took place in Orlando Florida in July 2019 The total of 1274 papers and 209 posters included in the 35 HCII 2019 proceedings volumes was carefully reviewed and selected from 5029 submissions The 208 papers presented in these three volumes are organized in topical sections as follows Part I design development and evaluation methods and technique multimodal Interaction security and trust accessibility and universal access design and user experience case studies Part II interacting with games human robot interaction AI and machine learning in HCI physiological measuring object motion and activity recognition virtual and augmented reality intelligent interactive environments Part III new trends in social media HCI in business learning technologies HCI in transport and autonomous driving HCI for health and well being     **The Data Bonanza** Malcolm Atkinson,Rob Baxter,Peter Brezany,Oscar Corcho,Michelle Galea,Mark Parsons,David Snelling,Jano van Hemert,2013-03-19 Complete guidance for mastering the tools and techniques of the digital revolution With the digital revolution opening up tremendous opportunities in many fields there is a growing need for skilled professionals who can develop data intensive systems and extract information and knowledge from them This book frames for the first time a new systematic approach for tackling the challenges of data intensive computing providing decision makers and technical experts alike with practical tools for dealing with our exploding data collections Emphasizing data intensive thinking and interdisciplinary collaboration The Data Bonanza Improving Knowledge Discovery in Science Engineering and Business examines the essential components of knowledge discovery surveys many of the current research efforts worldwide and points to new areas for innovation Complete with a wealth of examples and DISPEL based methods demonstrating how to gain more from data in real world systems the book Outlines the concepts and rationale for implementing data intensive computing in organizations Covers from the ground up problem solving strategies for data analysis in a data rich world Introduces techniques for data intensive engineering using the Data Intensive Systems Process Engineering Language DISPEL Features in depth case studies in customer relations environmental hazards seismology and more Showcases successful applications in areas ranging from astronomy and the humanities to transport engineering Includes sample program snippets throughout the text as well as additional materials on a companion website The Data Bonanza is a must have guide for information strategists data analysts and engineers in business research and government and for anyone wishing to be on the cutting edge of data mining machine learning databases distributed systems or large scale computing

**Laboratory Exercises in Introductory Astronomy** Charles Morse Huffer, Richard Spencer Marasso, 1967      **Cases on Distance Delivery and Learning Outcomes: Emerging Trends and Programs** Gearhart, Deb, 2009-10-31 This book provides practitioners in the field of distance education a case book that is a valuable reference of best practices in the field Provided by publisher      *New Trends in Astronomy Teaching* L. Gouguenheim, D. McNally, J. R. Percy, 1998-10 How do students learn astronomy How can the World Wide Web be used to teach And how do planetariums help with educating the public These are just some of the timely questions addressed in this stimulating review of new trends in the teaching of astronomy Based on an international meeting hosted by the University of London and the Open University IAU Colloquium 162 this volume presents articles by experts from around the world The proceedings of the first IAU Colloquium 105 The Teaching of Astronomy edited by Percy and Pasachoff were first published in 1990 and soon became established as the definitive resource for astronomy teachers Astronomy education has advanced enormously in the intervening 7 years and this sequel will inspire and encourage teachers of astronomy at all levels and provide them with wealth of ideas and experience on which to build      *Proceedings of the Twenty Sixth General Assembly Prague 2006* International Astronomical Union. General Assembly, 2008-12-18 IAU Transactions XXVIB contains the Proceedings of the IAU XXVII General Assembly held in Prague 14-25 August 2006 hosting a total of 2412 participants from 73 countries The Assembly featured a rich scientific program comprising 6 Symposia 17 Joint Discussions and 7 Special Sessions During the program about 650 papers were presented and more than 1550 posters displayed The Proceedings of the 6 Symposia have been published in the Proceedings of the IAU Symposia Series and the proceedings of the Joint Discussions and Special Sessions feature in IAU Highlights of Astronomy 14 Together with those 7 volumes these Transactions cover the entire General Assembly In addition to the scientific program the XXVI General Assembly hosted the regular Business Meetings of the EC the 12 Divisions 40 Commissions and 75 Working Groups This volume records the organizational and administrative business of the XXVI General Assembly and the status of the IAU membership      **Astronomy** Michael A. Seeds, 2005      **Implications of Open Access Repositories Quality Criteria and Features for Teachers' TPACK Development** Rita Tavares, António Moreira, 2017-06-27 This brief will explore how open access repositories are being developed and maintained in order to provide disseminate and promote the development of digital educational resources The main objective is to analyse open access repositories quality criteria and features and how these can improve teachers Technological Pedagogical Content Knowledge TPACK development It is organized in six major sections Section one addresses an historical overview of open access repositories In section two the authors present the objectives and the methodology used in the present study Sections three four and five analyse namely i the prevalence of European Science Education open access repositories and teachers perceptions of those same repositories ii the most common European Science Education open access repositories features and their implications and iii the impact of open access repositories usage on teachers TPACK development The last section

focuses on the analyses of a selected open access repository House of Sciences originally Casa Das Ci ncias addressing its characteristics and features the impact of social media features in digital educational resources re use and the relationship between repository quality criteria and teachers TPACK development

### **NSTA Guide to Planning School Science**

**Facilities** LaMoine L. Motz,James T. Biehle,Sandra S. West,2007 NSTA Guide to Planning School Science Facilities will help science teachers district coordinators school administrators boards of education and schoolhouse architects understand differences and develop science facilities that will serve students for years to come

*Highlights of Astronomy* International

Astronomical Union,2006 Vol 1 contain papers etc from 13th General Assembly

**The Psychology of Curiosity: Why We Can't Stop Asking "Why"** Güven Duysak,2025-08-20 Curiosity is more than a trait it is a driving force that shapes our experiences decisions and innovations From the moment humans first gazed at the stars asked why rivers flowed or imagined stories around campfires curiosity has propelled exploration learning and discovery This book is a journey into that powerful human impulse the desire to know to question to explore and to understand In a world overflowing with information yet filled with complexity and uncertainty curiosity is both compass and fuel It guides leaders through uncharted challenges inspires artists and musicians to create works that resonate across time and motivates scientists to unlock the mysteries of nature and the mind It is curiosity that turns obstacles into opportunities questions into insights and ideas into transformative action This book explores curiosity across multiple dimensions from individual growth and decision making to leadership science art culture technology and global challenges Each chapter delves into how curiosity shapes human thought behavior and society illustrating its profound impact with stories examples and research It is a map of inquiry showing how the simplest question Why can lead to the most extraordinary discoveries Whether you are a student professional creator or simply someone who wonders about the world this book invites you to embrace curiosity It encourages you to ask questions challenge assumptions and explore new possibilities Curiosity is not a destination it is a lifelong journey one that expands knowledge deepens understanding and enriches experience As you read these pages allow yourself to be inspired provoked and awakened by the power of curiosity Let it guide you through ideas stories and insights and let it remind you that every question you ask is a step toward growth innovation and a more thoughtful connected world Welcome to the journey of curiosity

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