

# POGIL

## Conceptual Physics Volume 2 Designed to Support the NGSS\*



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**Mare Sullivan**  
**Editor**

# Pogil Activities For Physics

**Shawn R. Simonson**



## **Pogil Activities For Physics:**

**POGIL** Shawn R. Simonson, 2023-07-03 Process Oriented Guided Inquiry Learning POGIL is a pedagogy that is based on research on how people learn and has been shown to lead to better student outcomes in many contexts and in a variety of academic disciplines Beyond facilitating students mastery of a discipline it promotes vital educational outcomes such as communication skills and critical thinking Its active international community of practitioners provides accessible educational development and support for anyone developing related courses Having started as a process developed by a group of chemistry professors focused on helping their students better grasp the concepts of general chemistry The POGIL Project has grown into a dynamic organization of committed instructors who help each other transform classrooms and improve student success develop curricular materials to assist this process conduct research expanding what is known about learning and teaching and provide professional development and collegiality from elementary teachers to college professors As a pedagogy it has been shown to be effective in a variety of content areas and at different educational levels This is an introduction to the process and the community Every POGIL classroom is different and is a reflection of the uniqueness of the particular context the institution department physical space student body and instructor but follows a common structure in which students work cooperatively in self managed small groups of three or four The group work is focused on activities that are carefully designed and scaffolded to enable students to develop important concepts or to deepen and refine their understanding of those ideas or concepts for themselves based entirely on data provided in class not on prior reading of the textbook or other introduction to the topic The learning environment is structured to support the development of process skills such as teamwork effective communication information processing problem solving and critical thinking The instructor s role is to facilitate the development of student concepts and process skills not to simply deliver content to the students The first part of this book introduces the theoretical and philosophical foundations of POGIL pedagogy and summarizes the literature demonstrating its efficacy The second part of the book focusses on implementing POGIL covering the formation and effective management of student teams offering guidance on the selection and writing of POGIL activities as well as on facilitation teaching large classes and assessment The book concludes with examples of implementation in STEM and non STEM disciplines as well as guidance on how to get started Appendices provide additional resources and information about The POGIL Project

*Teaching at Its Best* Linda B. Nilson, 2016-07-18 The classic teaching toolbox updated with new research and ideas Teaching at Its Best is the bestselling research based toolbox for college instructors at any level in any higher education setting Packed with practical guidance proven techniques and expert perspectives this book helps instructors improve student learning both face to face and online This new fourth edition features five new chapters on building critical thinking into course design creating a welcoming classroom environment helping students learn how to learn giving and receiving feedback and teaching in multiple modes along with the latest research and new questions to facilitate

faculty discussion Topics include new coverage of the flipped classroom cutting edge technologies self regulated learning the mental processes involved in learning and memory and more in the accessible format and easy to understand style that has made this book a much valued resource among college faculty Good instructors are always looking for ways to improve student learning With college classrooms becoming increasingly varied by age ability and experience the need for fresh ideas and techniques has never been greater This book provides a wealth of research backed practices that apply across the board Teach students practical real world problem solving Interpret student ratings accurately Boost motivation and help students understand how they learn Explore alternative techniques formats activities and exercises Given the ever growing body of research on student learning faculty now have many more choices of effective teaching strategies than they used to have along with many more ways to achieve excellence in the classroom Teaching at Its Best is an invaluable toolbox for refreshing your approach and providing the exceptional education your students deserve **Overcoming Students'**

**Misconceptions in Science** Mageswary Karpudewan,Ahmad Nurulazam Md Zain,A.L. Chandrasegaran,2017-02-28 This book discusses the importance of identifying and addressing misconceptions for the successful teaching and learning of science across all levels of science education from elementary school to high school It suggests teaching approaches based on research data to address students common misconceptions Detailed descriptions of how these instructional approaches can be incorporated into teaching and learning science are also included The science education literature extensively documents the findings of studies about students misconceptions or alternative conceptions about various science concepts Furthermore some of the studies involve systematic approaches to not only creating but also implementing instructional programs to reduce the incidence of these misconceptions among high school science students These studies however are largely unavailable to classroom practitioners partly because they are usually found in various science education journals that teachers have no time to refer to or are not readily available to them In response this book offers an essential and easily accessible guide Teaching Einsteinian Physics in Schools Magdalena Kersting,David Blair,2021-08-30 In our world today scientists and technologists speak one language of reality Everyone else whether they be prime ministers lawyers or primary school teachers speak an outdated Newtonian language of reality While Newton saw time and space as rigid and absolute Einstein showed that time is relative it depends on height and velocity and that space can stretch and distort The modern Einsteinian perspective represents a significant paradigm shift compared with the Newtonian paradigm that underpins most of the school education today Research has shown that young learners quickly access and accept Einsteinian concepts and the modern language of reality Students enjoy learning about curved space photons gravitational waves and time dilation often they ask for more A consistent education within the Einsteinian paradigm requires rethinking of science education across the entire school curriculum and this is now attracting attention around the world This book brings together a coherent set of chapters written by leading experts in the field of Einsteinian physics education The book begins by exploring

the fundamental concepts of space time light and gravity and how teachers can introduce these topics at an early age A radical change in the curriculum requires new learning instruments and innovative instructional approaches Throughout the book the authors emphasise and discuss evidence based approaches to Einsteinian concepts including computer based tools geometrical methods models and analogies and simplified mathematical treatments Teaching Einsteinian Physics in Schools is designed as a resource for teacher education students primary and secondary science teachers and for anyone interested in a scientifically accurate description of physical reality at a level appropriate for school education

Handbook of STEM Faculty Development Sandra M. Linder, Cindy M. Lee, Shannon K Stefl, Karen A. High, 2022-12-01 Faculty in the science technology engineering and mathematics STEM disciplines face intensifying pressures in the 21st century including multiple roles as educator researcher and entrepreneur In addition to continuously increasing teaching and service expectations faculty are engaged in substantive research that requires securing external funding mentoring other faculty and graduate students and disseminating this work in a broad range of scholarly outlets Societal needs of their expertise include discovery innovation and workforce development It is critical to provide STEM faculty with the professional development to support their complex roles and to base this development on evidence derived from research This edited handbook provides STEM stakeholders with an opportunity to share studies and or experiences that explore STEM faculty development FD in higher education settings More specifically we include work that examines faculty development planning techniques models experiences and outcomes focused on supporting the teaching research service and leadership responsibilities of STEM faculty The Handbook is suited for researchers and practitioners in STEM STEM Education Mathematics Science Technology and Engineering disciplines It is also suited towards faculty developers higher education administrators funding agencies industry leaders and the STEM community at large This handbook is organized around three constructs INPUTS MECHANISMS and OUTPUTS The STEM faculty development inputs construct focuses on topics related to the characteristics of faculty members and institutions that serve as barriers or supports to the adoption and implementation of holistic STEM faculty development programs Questions addressed in the handbook around this topic include What barriers supports exist for STEM faculty How are these barriers supports being addressed through STEM FD How do contexts e g economic political historical influence faculty administrative needs related to STEM FD How do demographics e g gender ethnicity age family background influence faculty administrative needs related to STEM FD The STEM faculty development mechanisms construct focuses on topics related to the actual implementation of STEM faculty development and we consider the potential models or structures of STEM faculty development that are currently in place or conceptualized in theory Questions addressed in the handbook around this topic include What are the processes for developing models of STEM FD What are effective models of STEM FD How is effectiveness determined What roles do stakeholders e g faculty administration consultants play within STEM FD mechanisms The STEM faculty development outputs construct focuses on

how to best understand the influence of STEM faculty development on outcomes such as productivity teacher quality and identity in relation to faculty development Questions addressed in the handbook around this topic include How has STEM FD influenced higher education practices and settings What are appropriate output measures and how are they used in practice What collaborations emerge from STEM FD How does STEM FD affect other STEM stakeholders e g students administration business community The aim for this handbook was to examine the multifaceted demands of faculty roles and together with members of the STEM education community envision pathways through which universities and individuals may support STEM colleagues regardless of their experience or rank to enjoy long and satisfying careers Our hope is for these chapters to aid readers in deep reflection on challenges faculty face to contemplate adaptations of models presented and to draw inspiration for creating or engaging in new professional development programs Chapters across this handbook highlight a variety of institutional contexts from 2 year technical colleges to teaching focused institutions in addition to research centric settings Some chapters focus primarily on teaching and learning practices and offer models for improving STEM instruction Others focus on barriers that emerge for STEM faculty when trying to engage in development experiences There are chapters that examine tenure structures in relation to faculty development and how STEM FD efforts could support research endeavors Mentorship and leadership models are also addressed along with a focus on equity issues that permeate higher education and impact STEM FD It is our sincere hope that this Handbook sparks increased discourse and continued explorations related to STEM FD and in particular the intentional focus of faculty development initiatives to extend to the many facets of academic life

Active Learning: Theoretical Perspectives, Empirical Studies and Design Profiles Robert Cassidy, Elizabeth S. Charles, James D. Slotta, Nathaniel Lasry, 2019-07-11 This book represents the emerging efforts of a growing international network of researchers and practitioners to promote the development and uptake of evidence based pedagogies in higher education at something a level approaching large scale impact By offering a communication venue that attracts and enhances much needed partnerships among practitioners and researchers in pedagogical innovation we aim to change the conversation and focus on how we work and learn together i e extending the implementation and knowledge of co design methods In this first edition of our Research Topic on Active Learning we highlight two of the three types of publications we wish to promote First are studies aimed at understanding the pedagogical designs developed by practitioners in their own practices by bringing to bear the theoretical lenses developed and tested in the education research community These types of studies constitute the practice pull that we see as a necessary counterbalance to knowledge push in a more productive pedagogical innovation ecosystem based on research practitioner partnerships Second are studies empirically examining the implementations of evidence based designs in naturalistic settings and under naturalistic conditions Interestingly the teams conducting these studies are already exemplars of partnerships between researchers and practitioners who are uniquely positioned as in between straddling the two worlds As a result these publications represent

both the rigours of research and the pragmatism of reflective practice In forthcoming editions we will add to this collection a third type of publication design profiles These will present practitioner developed pedagogical designs at varying levels of abstraction to be held to scrutiny amongst practitioners instructional designers and researchers alike We hope by bringing these types of studies together in an open access format that we may contribute to the development of new forms of practitioner researcher interactions that promote co design in pedagogical innovation

**Argumentation in Chemistry Education** Sibel Erduran,2022-06-29 Scientists use arguments to relate the evidence that they select from their investigations and to justify the claims that they make about their observations This book brings together leading researchers to draw attention to research policy and practice around the inclusion of argumentation in chemistry education

**Process Oriented Guided Inquiry Learning (POGIL)** Richard Samuel Moog,2008 POGIL is a student centered group learning pedagogy based on current learning theory This volume describes POGIL s theoretical basis its implementations in diverse environments and evaluation of student outcomes

**Chemistry Education in the ICT Age** Minu Gupta Bhowon,Sabina Jhaumeer-Laulloo, Henri Li Kam Wah, Ponnadurai Ramasami,2009-07-21 The 20 International Conference on Chemical Education 20 ICCE which had Chemistry in the ICT Age as the theme was held from 3 to 8 August 2008 at Le Meridien Hotel Pointe aux Piments in Mauritius With more than 200 participants from 40 countries the conference featured 140 oral and 50 poster presentations Participants of the 20 ICCE were invited to submit full papers and the latter were subjected to peer review The selected accepted papers are collected in this book of proceedings This book of proceedings encloses 39 presentations covering topics ranging from fundamental to applied chemistry such as Arts and Chemistry Education Biochemistry and Biotechnology Chemical Education for Development Chemistry at Secondary Level Chemistry at Tertiary Level Chemistry Teacher Education Chemistry and Society Chemistry Olympiad Context Oriented Chemistry ICT and Chemistry Education Green Chemistry Micro Scale Chemistry Modern Technologies in Chemistry Education Network for Chemistry and Chemical Engineering Education Public Understanding of Chemistry Research in Chemistry Education and Science Education at Elementary Level We would like to thank those who submitted the full papers and the reviewers for their timely help in assessing the papers for publication We would also like to pay a special tribute to all the sponsors of the 20 ICCE and in particular the Tertiary Education Commission <http://tec.intnet.mu> and the Organisation for the Prohibition of Chemical Weapons <http://www.opcw.org> for kindly agreeing to fund the publication of these proceedings

**The Cambridge Handbook of Computing Education Research** Sally A. Fincher,Anthony V. Robins,2019-02-13 This is an authoritative introduction to Computing Education research written by over 50 leading researchers from academia and the industry

**Formative Assessment for 3D Science Learning** Erin Marie Furtak,2023 The current wave of science education reforms emphasizes more equitable opportunities for students as they learn disciplinary core ideas and apply crosscutting concepts by engaging in the practices of scientists Formative assessment the assessment teachers and students conduct

while learning is in progress also needs to shift to support this vision This book combines three dimensional science learning sociocultural theories of learning and science for justice and equity to provide a comprehensive picture of formative assessment for today s K 12 science classroom Filled with practical examples and strategies the author provides guidance for classroom teachers around formative assessment task design that centers students interests and builds on the resources they bring to school The text explores the different enactment approaches teachers can use to prioritize and respond to students ideas as they are learning It also offers approaches to and resources for professional learning that support teachers as they engage in formative assessment for ambitious science instruction Book Features Provides a framework for designing and enacting 3D science assessments that support both rigorous and equitable instruction Advocates for formative assessment that evaluates the practices of scientific inquiry as opposed to measuring the memorization of science content Includes assessment tasks samples from classroom practice and transcriptions of classroom conversations with students Offers guidance for providing students with helpful feedback to advance their learning as well as suggestions for collaborating with colleagues Shows how formative assessment can be enacted across classrooms to create opportunities to coordinate practice at a larger scale By writing Formative Assessment for 3D Science Learning Professor Furtak has provided a generous resource for science teachers and school leaders She lets us see how the theory works What a wonderful and empowering professional gift From the Foreword by Lorrie A Shepard Distinguished Professor Emerita University of Colorado Boulder

**Broadening Participation in STEM** Zayika Wilson-Kennedy, Goldie S. Byrd, Eugene Kennedy, Henry T.

Frierson, 2019-02-28 This book reports on high impact educational practices and programs that have been demonstrated to be effective at broadening the participation of underrepresented groups in the STEM disciplines Teaching at Its Best Todd D. Zakrajsek, Linda B. Nilson, 2023-02-02 A complete accessible evidence based guide to better teaching in higher education This higher education playbook provides a wealth of research backed practices for nearly every aspect of effective teaching throughout higher education It is filled with practical guidance and proven techniques designed to help you improve student learning both face to face and online Already a bestselling research based toolbox written for college instructors of any experience level Teaching at Its Best just got even better What is new A lot For this updated 5th edition Todd Zakrajsek joins Linda Nilson to create a powerful collaboration drawing on nearly 90 combined years as internationally recognized faculty developers and faculty members One of the most comprehensive books on effective teaching and learning the 5th edition of Teaching at its Best brings new concepts new research and additional perspectives to teaching in higher education In this book you will find helpful advice on active learning interactive lecturing self regulated learning the science of learning giving and receiving feedback and so much more Each chapter has been revised where necessary to reflect current higher education pedagogy and now includes two reflection questions and one application prompt to reflect on your teaching and stimulate peer discussions Discover the value of course design and how to write effective learning outcomes Learn which



educational technology is worthwhile and which is a waste of time Create a welcoming classroom environment that boosts motivation Explore detailed explanations of techniques formats activities and exercises both in person and online Enjoy reading about teaching strategies and educational concepts Whether used as a resource for new and seasoned faculty a guide for teaching assistants or a tool to facilitate faculty development this research based book is highly regarded across all institutional types *Culturally Responsive Strategies for Reforming STEM Higher Education* Kelly M. Mack,Kate

Winter,Melissa Soto,2019-01-14 This book chronicles the introspective and contemplative strategies employed within a uniquely designed professional development intervention that successfully increased the self efficacy of STEM faculty in implementing culturally relevant pedagogies in the computer information sciences **Chemists' Guide to Effective**

**Teaching** Norbert J. Pienta,Melanie M. Cooper,Thomas J. Greenbowe,2005 Part of the Prentice Hall Series in Educational Innovation for Chemistry this unique book is a collection of information examples and references on learning theory teaching methods and pedagogical issues related to teaching chemistry to college students In the last several years there has been considerable activity and research in chemical education and the materials in this book integrate the latest developments in chemistry Each chapter is written by a chemist who has some expertise in the specific technique discussed has done some research on the technique and has applied the technique in a chemistry course **Mentoring Science Teachers in the**

**Secondary School** Saima Salehjee,2020-12-14 This practical guide helps mentors of new science teachers in both developing their own mentoring skills and providing the essential guidance their trainees need as they navigate the rollercoaster of the first years in the classroom Offering tried and tested strategies based on the best research it covers the knowledge skills and understanding every mentor needs and offers practical tools such as lesson plans and feedback guides observation sheets and examples of dialogue with trainees Together with analytical tools for self evaluation this book is a vital source of support and inspiration for all those involved in developing the next generation of outstanding science teachers Key topics explained include Roles and responsibilities of mentors Developing a mentor mentee relationship Guiding beginning science teachers through the lesson planning teaching and self evaluation processes Observations and pre and post lesson discussions and regular mentoring meetings Supporting beginning teachers to enhance scientific knowledge and effective pedagogical practices Building confidence among beginning teachers to cope with pupils contingent questions and assess scientific knowledge and skills Supporting beginning teachers planning and teaching to enhance scientific literacy and inquiry among pupils Developing autonomous science teachers with an attitude to promote the learning of science for all the learners Filled with tried and tested strategies based on the latest research *Mentoring Science Teachers in the Secondary School* is a vital guide for mentors of science teachers both trainee and newly qualified with ready to use strategies that support and inspire both mentors and beginning teachers alike BIC 2021 Silvianetri,Nil Firdaus,M. Husni Shidqi,Oktri

Permata Lani,Wilda Fathia,Adam Mudinillah,Avid Leonardo Sari,Irwandi,Robbi Rahim,2022-08-17 The Proceedings of

Batusangkar International Conference VI BIC VI that was organized by Graduate Program of IAIN Batusangkar was held in hybrid platform on 11 12 October 2021 with the main theme Strengthening Life Harmony in 4 0 Era The BIC VI conference includes several interesting topics such as Science Technology Literacy Engineering Law Economy Education and Religion The participants came from various universities and practitioners with a total of 140 papers that were published in a proceedings It is expected that this proceedings will bring contribution and insight resulting in new knowledge inspirations and collaborations We are very grateful for their participation We hope to meet you again in the next edition BIC VII or BICoSecH VII

**Chemical Pedagogy** Keith S Taber, 2024-12-20 How should chemistry be taught in schools colleges and universities Chemical Pedagogy discusses teaching approaches and techniques the reasoning behind them and the evidence for their effectiveness The book surveys a wide range of different pedagogic strategies and tactics that have been recommended to better engage learners and provide more effective chemistry teaching These accounts are supported by an initial introduction to some key ideas and debates about pedagogy the science of teaching Chemical Pedagogy discusses how teaching innovations can be tested to inform research based practice Through this book the author explores the challenges of carrying out valid experimental studies in education and the impediments to generalising study results to diverse teaching and learning contexts As a result the author highlights both the need to read published studies critically and the value of teachers and lecturers testing out recommended innovations in their own classrooms Chemical Pedagogy introduces core principles from research into human cognition and learning to provide a theoretical perspective on how to best teach for engagement and understanding An examination of some of the more contentious debates about pedagogy leads to the advice to seek optimally guided instruction which balances the challenge offered to learners with the level of support provided This provides a framework for discussing a wide range of teaching approaches and techniques that have been recommended to those teaching chemistry across educational levels including both those intended to replace teaching from the front and others that can be built into traditional lecture courses to enhance the learning experience

**Computer Supported Education** Beno Csapó, James Uhomoibhi, 2022-08-20 This book constitutes selected revised and extended papers from the 13th International Conference on Computer Supported Education CSEDU 2021 held as a virtual event in April 2021 The 27 revised full papers were carefully reviewed and selected from 143 submissions They were organized in topical sections as follows artificial intelligence in education information technologies supporting learning learning teaching methodologies and assessment social context and learning environments ubiquitous learning current topics

*Discipline-Based Education Research* National Research Council, Division of Behavioral and Social Sciences and Education, Board on Science Education, Committee on the Status, Contributions, and Future Directions of Discipline-Based Education Research, 2012-08-27 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 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 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 explore evidence on promising practices in undergraduate science technology engineering and mathematics STEM education This book asks questions that are essential to advancing DBER 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 this research currently influences undergraduate instruction and identifies the intellectual and material resources required to further develop DBER Discipline Based Education Research provides 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 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 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 scholars decision makers in universities government agencies curriculum developers research sponsors and education advocacy groups

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