Syllabus

PHYS 102 Modern Physics with CURE/PBL

(PHYS102-01-74912-2197)

(Updated on 9/10/2019)

Introduction and Course Description

This three-unit-upper-division physics course will introduce the development of Modern Physics, which started from in the end of 19th and beginning of 20th centuries and its transition from Classical Physics to Statistical Physics, Quantum Mechanics, and Relativity. These concepts include the wave-particle duality of light, wave functions and probabilities of particles, atomic and nuclear structure, energy level schemes and radiation, and the development of Solid State Physics.

Modern Physics is developed from the phenomena, unresolved experimental results, and technical challenges near the turn of the 20th centuries until now. Therefore, exemplary experiments, thinking process, setups, results, and technical application will be greatly emphasized.

A component Course-Based Undergraduate Research Experience (CURE)/ Project-Based Learning (PBL) is implemented in this course. Students (two per group) will have to choose and design a project based on Modern Physics to perform research-style activities. Examples of proposed projects can be thermal radiation related, such as solar cell, dye-sensitized-solar cell, heat-load analysis, and thermal-imaging analysis. In the end of semester, each group need to make a poster presentation at the University level to showcase the results.

PHYS 102 MODERN PHYSICS (PHYS102-01-74912-2197)	
Fall 2019	California State University, Fresno
Course Information	Instructor Name Pei-Chun Ho
Units: 3	Office Number – McLane Hall Room 254 & 255
Time: M, W: 11:00 AM – 12:15 PM	E-Mail pcho@csufresno.edu
Location: McLane Hall Room 258.	Telephone 559-278-5990
Website – To access the course login to Blackboard (http://blackboard.csufresno.edu) using your Fresno State username and password. For help with Blackboard contact Technology Innovations for Learning and Teaching at 278-7373 or send an email to tiltsupport@csufresno.edu.	Office Hours M & W: 12:15 PM — 1:30 PM (McL 254-255) T & Th: 7:45 PM — 8:45 PM (McL 162 or McL 254-255)

Prerequisites

***MATH 77 Calculus III*:** three-dimensional calculus, partial derivatives, multiple integrals, Green's Theorem, Stokes' Theorem.

***MATH 81 Applied Analysis (can be taken concurrently)*:** Introduction to ordinary linear differential equations and linear systems of differential equations; solutions by Laplace transforms. Solution of linear systems of equations; introduction to vector spaces; eigenvalues and eigenvectors.

***PHYS 4C Light and Modern Physics*:** Geometrical optics; electromagnetic radiation; physical optics; introduction to special relativity; quantum physics; and the physics of atoms, nuclei, and the solid state.

Required Textbooks and Materials

(1) Textbook: Modern Physics for Scientists and Engineers, Publisher Brooks Cole, 3rd or 4th edition, by Stephen T. Thornton and Andrew Rex.

(2) i'Clicker: Quick quizzes will be randomly given during lectures. Please prepare a **i'Clicker** for your class and bring it every lecture; fail to do so will result zero in your quick quizzes and attendance. Please also remember to **register your iClicker online** by using **iClicker Classic** (http://www.iclicker.com). Please note that the cellular phone app of iClicker (i.e., iClicker Reef or iClicker Cloud) is "not allowed" since you are required to turn off your cellular phone during the lecture sessions.

(3) **Scientific calculator** (**Graphing Calculator is Not allowed for this course**).

(4) An email and internet account at CSU-Fresno: available for fee at http://www.fresno.com/cvonline/cvip.html

(5) In order to compensate the time working on the CURE project outside of class meeting time, students are required to register 1 unit of PHYS 90 Dependent Study. Each student needs to prepare a notebook for experimental log and longhand notes for the CURE project.

Course Organization

This course will include assigned readings in your textbook that should be completed outside of the class session. During the class sessions there will be lectures, demonstrations, quick quizzes, small group discussions, and class discussions. In order to facilitate your understanding of assigned readings lectures may review portions of the readings, but they will not serve as a substitute for reading the materials. Important additional information will be presented during the lectures, which will be included in the exams.

In addition, a component of Course-Based Undergraduate Research Experience (CURE)/ Project-Based Learning (PBL) is implemented in this course. Students (two per group) will have to choose and design a project based on Modern Physics to perform research-style activities. Therefore, students can have a connection of the real-world case study.

Examinations and Major Assignments

Quick Quizzes and Class Participation

In order to encourage students preview the text book contents before lectures and also focus learning in class room, 1-5 questions will be randomly given as quick quizzes in some of the lectures, total of which will be counted as 12% of the weighted grades into students' grades in the end of the semester.

Homework

- Problem sets will be assigned on a weekly or session basis.
- Students can choose to do homework alone, or in study groups with discussion with other students.
- Detail procedures are required to show in the submitted homework.
  Homework will be due the following week after assignment and will be collected in class.
- Late homework will be counted as zero.

Exams

- Three exams will be offered in the course: two non-cumulative exams (i.e., midterms) throughout the semester, and one comprehensive final exam (two-hour length) at the University assigned schedule in the end of the semester.
- Exam questions will be written questions, all of which are based on quizzes, examples in lectures and text books, and assigned homework problems.
- All exams take place at the same room as lecture.
- Midterms will be offered at the beginning of the class session and will need to be completed within the allotted class time. *No additional time will be allowed for those arriving late for the exam.*
- All exams are **closed book**, and the **required fundamental constants** and **formulas** will be **provided. No cellular phone, electronic tablet, computer, iPod, walkman, or other electronic devices are allowed during the exams except a simple scientific calculator.**
- Either early or make-up exams for two midterms and final will not be allowed by the instructor. If a Midterm is missed for a compelling reason (e.g. illness documented by a physician's note), the part of the grade that midterm would have counted will be voided, and the rest of the grade will be counted as 100%. If the final exam is missed for a compelling reason (e.g. illness documented by a physician's note), the student will receive a grade of **"I"** (incomplete) for PHYS 102 for the semester. It will also be the student's responsibility to contact the university administration in a timely manner, and make the necessary arrangements to remove the **"I"** grade. Please check "the California State University Fresno General Catalog" for regulation regarding the **"I"** grade. Only students who can document very compelling reasons to miss final exams, e.g. with a physician's

note, will be eligible for incompletes; other students missing the final exam will receive 0% for the grade of final exam.

CURE (Course-Based Undergraduate Research Experience)/ PBL (Project-Based Learning)

In order to prepare students for academic, personal, and career success and readies them for the challenge of our environment on Earth and global competition, CURE/ PBL is implemented in this course. Students will work on a project over a semester to engage in solving a real-world problem or answering a complex question. As a result, students can develop deep content knowledge as well as critical thinking, creativity, and communication skills in the context of doing an authentic, meaningful project.

This component will be counted as 15% of the weighted grades into students' grades in the end of the semester. The grade distribution of CURE component list below.

I. Oral presentation of the proposal in a Power-Point format, 5%. (12 mins presentation + 3 mins questions. Submit the file before the oral presentation. Student should bring the require adapter for projector before the presentation.)
II. Oral midterm progress report by using a Power-Point format, 5%. (12 mins presentation + 3 mins questions. Submit the file before the oral presentation. Student should bring the require adapter for projector before the presentation.)
III. Final Power-Point "poster" presentation, 5%. (submit the draft 2 week before the poster presentation. Since the presentation is at the University level, students will be asked to explain the project and grade will come from the contributions of faculty members at the site, too.)
IV. In order to compensate the time working on the CURE project outside of class meeting sessions, students are required to register 1 unit of PHYS 90 Dependent Study. Each student needs to prepare a notebook for experimental log and longhand notes for the CURE project.

Study Expectations:

It is usually expected that students will spend approximately minimum of 2 hours of study time outside of class for every one hour in class. Since this is a 3-unit class, you should expect to study an minimum of 6 hours outside of class each week. Some students may need more outside study time and some less.

Students should bring the test book and all the handouts to the class, unless the instructor specifically informs the class that these materials will not be necessary during a particular class period. Notes should be taken during class. Good-quality and organized notes will help students' understanding of course materials.

To succeed in this course, a student must invest time and effort in carefully reading the text and assigned outside readings **prior to class**. A student may need to read sections of the text more than once. The instructor may call upon you at any time to discuss the assigned reading material

and the student will want to be prepared. Reading the material before class allows the student to ask timely questions about the material and permits the instructor to clarify areas of confusion.

This course is structured as a combination of reading, writing, self-study with a real-life project, quizzes, tests, and discussion. Assignments require reading (text book, online readings), discussing (group and class), writing (email discussions, quizzes, and assignments) and test taking. It is important to keep up with the assignments: check due dates and be sure the student complete the assignments on time.

For free tutoring on campus, contact the Learning Center (www.csufresno.edu/learningcenter) in the Collection Level (basement level) of the Henry Madden Library. You can reach them by phone at 278-3052.

Participation Standards

Attendance is mandatory. Random quick quizzes will be given every lecture, which is not allowed to be retaken.

Grading

A	100 – 87.00	**B**	86.99 – 74.00	**C**	73.99 – 60.00
D	59.99 – 50.00	**F**	49.99 - 0		

Weighted Grades:

Homework	15 %	
Two Midterms	34 %	(17% each)
Final Exam	24 %	
Quick Quizzes	12 %	
+) CURE / PBL	15 %	

(5% for proposal oral presentation, 5% for midterm oral progress report presentation, and 5% for final poster presentation)

Total possible points 100 % (**grade will not be curved.**)

Course Goals and Primary Learning Outcomes

Course Goals:

The main goal of the course will be to assist students in learning to describe, analyze, and predict the motions and energies of objects that are down to the atomic scale and moves at speed comparable to the speed of light.

Primary Learning Outcomes:

- Students will be able to analyze motion in the speed approaching the speed of light.
- Students will have the basic knowledge of quantum mechanics and use the Schrodinger equation to solve for simple wave functions.
- Students will be able to describe the subatomic motion with dual natures of particle and wave.
- Students will be able to analyze the structure of an atom.
- Students will be able to analyze the electronic motion and distribution of the hydrogen or hydrogen like atom.
- Students will have a basic understanding of elementary particles

Examination Schedule

Date/Module	Exam	Points
11 AM – 12:15 PM Wednesday 10/2/Module 7 McL 258	1st Midterm	100
11 AM – 12:15 PM Wednesday 11/13/Module 13 McL 258 or UC 201	2nd Midterm	100
11:00AM – 1:00 PM, Monday 12/16//Module 18 McLane 258	Final Exam	100

- Final Exam schedule is set by the University.
  http://www.fresnostate.edu/studentaffairs/classschedule/finals/

Subject to Change Statement

This syllabus and schedule are subject to change in the event of extenuating circumstances. If you are absent from class, it is your responsibility to check on announcements made while you were absent.

Course Policies & Safety Issues

Classroom Behavior

Both the instructor and the students are to adhere to high standards of professionalism, common courtesy, and respect for others. Please refrain from the following behaviors, bearing in mind that if your behavior interrupts the class you may be asked to leave the class for the rest of the period:

- Coming to class late, please use the back doors for entrance. If you must leave early, please sit near a door.
- During lecture sessions, **no using cell phones, laptops and other electronic devices that are not required in class.** Please turn off your phone before class.
- Disruptive behavior in class. This includes talking to others, reading newspapers, listening to ipods or walkman, smoking tobacco, etc. Please be ready to attend to the subject of the class; if you are not motivated to learn, please do not come and distract those who are motivated.
- Talking out of turn during class. This can be rude and disruptive. However, I am very interested in what you have to say, and will be happy to entertain questions and comments if you wait your turn.
- Speaking to anyone in a rude or aggressive fashion, or speaking of others in a disrespectful fashion.

Online communication guidelines: students should only contact the instructor you through Email, and phone. When sending an email, a student ***must*** *use a specific format type the last name and first initial in the 'subject' line along with the course number PHYS 102. Example: Doe, J. PHYS102.*

Course Assignments and Files. Students must keep a copy of their submitted materials (e.g. emails, discussion postings, assignments, etc.) as part of their coursework. Students are fully responsible for the timely re-submission of their work upon the instructor's request.

Plagiarism Detection:

The campus utilizes the SafeAssign plagiarism prevention service through Blackboard. In this course, students may be required to submit written assignments to SafeAssign. Submitted work will be used by SafeAssign for plagiarism detection and for no other purpose. The student may indicate in writing to the instructor that he/she refuses to participate in the SafeAssign process, in which case the instructor can use other electronic means to verify the originality of their work. SafeAssign Originality Reports **WILL be available for your viewing.**

University Policies

For information on the University's policy regarding cheating and plagiarism, refer to the Class Schedule (Legal Notices on Cheating and Plagiarism) or the University Catalog (Policies and

Regulations). Students can find the detail of the required syllabus policy statement in the following website:
http://www.fresnostate.edu/academics/policies-forms/instruction/syllabus.html

Students with Disabilities:

Upon identifying themselves to the instructor and the university, students with disabilities will receive reasonable accommodation for learning and evaluation. For more information, contact Services to Students with Disabilities in the Henry Madden Library, Room 1202 (278-2811).

Honor Code:

"Members of the CSU Fresno academic community adhere to principles of academic integrity and mutual respect while engaged in university work and related activities." You should:

a) understand or seek clarification about expectations for academic integrity in this course (including no cheating, plagiarism and inappropriate collaboration)

b) neither give nor receive unauthorized aid on examinations or other course work that is used by the instructor as the basis of grading.

c) take responsibility to monitor academic dishonesty in any form and to report it to the instructor or other appropriate official for action.

Instructors may require students to sign a statement at the end of all exams and assignments that "I have done my own work and have neither given nor received unauthorized assistance on this work." If you are going to use this statement, include it here.

Cheating and Plagiarism:

"Cheating is the actual or attempted practice of fraudulent or deceptive acts for the purpose of improving one's grade or obtaining course credit; such acts also include assisting another student to do so. Typically, such acts occur in relation to examinations. However, it is the intent of this definition that the term 'cheating' not be limited to examination situations only, but that it include any and all actions by a student that are intended to gain an unearned academic advantage by fraudulent or deceptive means. Plagiarism is a specific form of cheating which consists of the misuse of the published and/or unpublished works of others by misrepresenting the material (i.e., their intellectual property) so used as one's own work." Penalties for cheating and plagiarism range from a 0 or F on a particular assignment, through an F for the course, to expulsion from the university. For more information on the University's policy regarding cheating and plagiarism, refer to the Class Schedule (Legal Notices on Cheating and Plagiarism) or the University Catalog (Policies and Regulations).

Computers:

"At California State University, Fresno, computers and communications links to remote resources are recognized as being integral to the education and research experience. Every student is required to have his/her own computer or have other personal access to a workstation (including a modem and a printer) with all the recommended software. The minimum and recommended standards for the workstations and software, which may vary by academic major, are updated periodically and are available from Information Technology Services (http://www.csufresno.edu/ITS/) or the University Bookstore. In the curriculum and class assignments, students are presumed to have 24-hour access to a computer workstation and the necessary communication links to the University's information resources."

Disruptive Classroom Behavior:

"The classroom is a special environment in which students and faculty come together to promote learning and growth. It is essential to this learning environment that respect for the rights of others seeking to learn, respect for the professionalism of the instructor, and the general goals of academic freedom are maintained. ... Differences of viewpoint or concerns should be expressed in terms which are supportive of the learning process, creating an environment in which students and faculty may learn to reason with clarity and compassion, to share of themselves without losing their identities, and to develop and understanding of the community in which they live . . . Student conduct which disrupts the learning process shall not be tolerated and may lead to disciplinary action and/or removal from class."

Copyright policy:

Copyright laws and fair use policies protect the rights of those who have produced the material. The copy in this course has been provided for private study, scholarship, or research. Other uses may require permission from the copyright holder. The user of this work is responsible for adhering to copyright law of the U.S. (Title 17, U.S. Code). To help you familiarize yourself with copyright and fair use policies, the University encourages you to visit its Copyright Web Page (http://www.fresnostate.edu/home/about/copyright.html).

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Tentative Course Schedule

The schedule and procedures for this course are subject to change in the event of extenuating circumstances.

Tentative Course Schedule
Fall, AY 2019-20
Weekly Online Modules

	Start Date/End Date	Topic	Include a list of : Assignments, Activities, Readings, Quizzes, Optional Resources, etc.
Module 1	W., 8/21 **Fall Instruction Begin**	Course Syllabus & General Rules Introduction to Modern Physics, unresolved Questions of 1895 Review of Classical Statistics	Introduction of CURE/PBL Ch1 The birth of modern physics Ch9 Statistical physics 9.1 Historic Overview Entropy –Degeneracy
Module 2	Mon., 8/26	Maxwell Boltzmann Statistics	Ch9 Statistical physics 9.2 Maxwell Velocity Distribution
	Wed., 8/28	Quantum Statistics Two classes of particles: Fermions Bosons	Ch9 Statistical physics 9.3 Equipartition Theorem 9.4 Maxwell Speed Distribution
Module 3	Mon., 9/2	**Labor Day Campus Close**	
	Wed., 9/4	Quantum Statistics Two classes of particles: Fermions Bosons	Ch9 Statistical physics 9.5 Classical and Quantum Statistics 9.6 Fermi-Dirac Statistics
Module 4	Mon., 9/9	Quantum Statistics: Fermi-Dirac Statistics	Ch9 Statistical physics 9.6 Fermi-Dirac Statistics
	Wed., 9/11 **(LAST DAY to drop/withdraw online without permission)**	Quantum Statistics: Bose-Einstein Statistics	Ch9 Statistical physics 9.7 Bose-Einstein Statistics
Module 5	Mon., 9/16	New discoveries in the end of 19th century Black Body Radiation	Ch3 The experimental basis of quantum theory 3.1 Discovery of X-ray and Electrons, line spectra, and helium 3.2 Determination of Electron Charge
	Wed., 9/18 **(LAST DAY to add a class with permission)**	Black Body Radiation Transition from Classical interpretation to Quantum	Ch3 The experimental basis of quantum theory 3.3 Line Spectra 3.4 Quantization

	Start Date/End Date	Topic	Include a list of : Assignments, Activities, Readings, Quizzes, Optional Resources, etc.
		Explanation in Statistics	3.5 Blackbody Radiation
Module 6	Mon., 9/23	**CURE**	**Project Proposal PPTx Oral Presentation**
	Wed., 9/25	Particle property of Light – Photon	Ch3 The experimental basis of quantum theory 3.6 Photoelectric Effect 3.7 X-ray Production
Module 7	Mon., 9/30	Particle property of Light – Photon	Ch3 The experimental basis of quantum theory 3.8 Compton Effect 3.9 Pair Production and Annihilation
	Wed., 10/2	**1st Midterm at McL 258 11 AM – 12:15 PM**	
Module 8	Mon., 10/7	Atomic Model and Rutherford Scattering Classical Atomic Model and Bohr's Model for Hydrogen Atom	Ch4 Structure of the Atom 4.1 The Atomic Model of Thompson and Rutherford 4.2 Rutherford Scattering
	Wed., 10/9	Characteristic X-ray and spectroscopy	Ch4 Structure of the Atom 4.3 The Classical Atomic Model 4.4The Bohr Model of the Hydrogen Model 4.5 Success and Failure of the Bohr Model
Module 9	Mon., 10/14	X-ray Scattering and Crystallography	Ch4 Structure of the Atom 4.6 Characteristic X-ray Spectra and Atomic Number 4.7 Atomic Excitation by Electrons
	Wed., 10/16	Wave nature of Particles	Ch5 Wave properties of matter and quantum mechanics I 5.1 X-ray Scattering 5.2 De Broglie Waves
Module 10	Mon., 10/21	Wave-Particle Duality Concept of Probability and Wave Function of a Particle	Ch5 Wave properties of matter and quantum mechanics Wave-Particle Duality 5.3 Electron Scattering 5.4 Wave Motion
	Wed., 10/23	Uncertainty Principle	Ch5 Wave properties of matter and quantum mechanics Wave-Particle Duality 5.5 Wave or Particles? 5.6 Uncertainty Principle

	Start Date/End Date	Topic	Include a list of : Assignments, Activities, Readings, Quizzes, Optional Resources, etc.
Module 11	Mon., 10/28	Particle in a Box	Ch5 Wave properties of matter and quantum mechanics Wave-Particle Duality 5.7 Probability, Wave Functions, and the Copenhagen Interpretation 5.8 Particle in a Box
	Wed., 10/30	**CURE**	**Project Progress Report PPTX Oral Presentation**
Module 12	Mon., 11/4 **(Spring 2020 Registration Begins)**	Application of the Schrödinger Equation to Solve for a Wave Function	Ch6 Quantum Mechanics II 6.1 The Schrodinger Wave Equation 6.2 Expectation Values
	Wed., 11/6	Application of the Schrödinger Equation to Solve for a Wave Function	Ch6 Quantum Mechanics II 6.3 Infinite Square-Well Potential 6.4 Finite Square-Well Potential
Module 13	Mon., 11/11	**Veteran Day Campus Close**	
	Wed., 11/13	**2nd Midterm either at McL 258 or at Bulldog Testing Center, UC 201**	
Module 14	Mon., 11/18	Application of the Schrödinger Equation to Solve for a Wave Function	Ch6 Quantum Mechanics II 6.3 Infinite Square-Well Potential 6.4 Finite Square-Well Potential
	Wed., 11/20	Application of the Schrödinger Equation to Solve for a Wave Function	Ch6 Quantum Mechanics II 6.5 Three-Dimensional Infinite Potential Well 6.6 Simple Harmonic Oscillator
Module 15	Mon., 11/25	Application of the Schrödinger Equation to Solve for a Wave Function	Ch6 Quantum Mechanics II 6.7 Barrier and Tunneling
	Wed., 11/27	**Thanksgiving Break Nov. 27, Campus Close on 28 & 29)**	
Module 16	Mon., 12/2	Energies and Quantum States for Hydrogen-Like Atoms	Ch7 The hydrogen atom 7.1 Application of the Schrodinger Equation to the Hydrogen Atoms

	Start Date/End Date	Topic	Include a list of : Assignments, Activities, Readings, Quizzes, Optional Resources, etc.
	Wed., 12/4	Energies and Quantum States for Hydrogen-Like Atoms	Ch7 The hydrogen atom 7.2 Solution of the Schrodinger Equation for Hydrogen
Module 17	Mon., 12/9	Energies and Quantum States for Hydrogen-Like Atoms	Ch7 The hydrogen atom 7.3 Quantum numbers 7.4 Magnetic Effects on Atomic Spectra – The Normal Zeeman Effect
	Wed., 12/11 **(Last Day of Instruction)**	Energies and Quantum States for Hydrogen-Like Atoms	Ch7 The hydrogen atom 7.5 Intrinsic Spin 7.6 Energy Levels and Electron Probabilities
	Fri. 12/13	**CURE PPTx Poster Presentation Location TBA by CSM**	
Module 18	**Mon., 12/16**	**Final Exam at McL 258 11 AM – 1:00 PM**	

Finals week	Days	Dates
Final Exam Preparation & Faculty Consultation Days:	Thursday and Friday	12/12 & 12/13
Final Semester Examinations	Monday-Thursday	12/16 – 12/19
Final Exam in this course	**Monday 11:00AM – 1:00 PM McLane 258**	**12/16**

Appendix for CURE

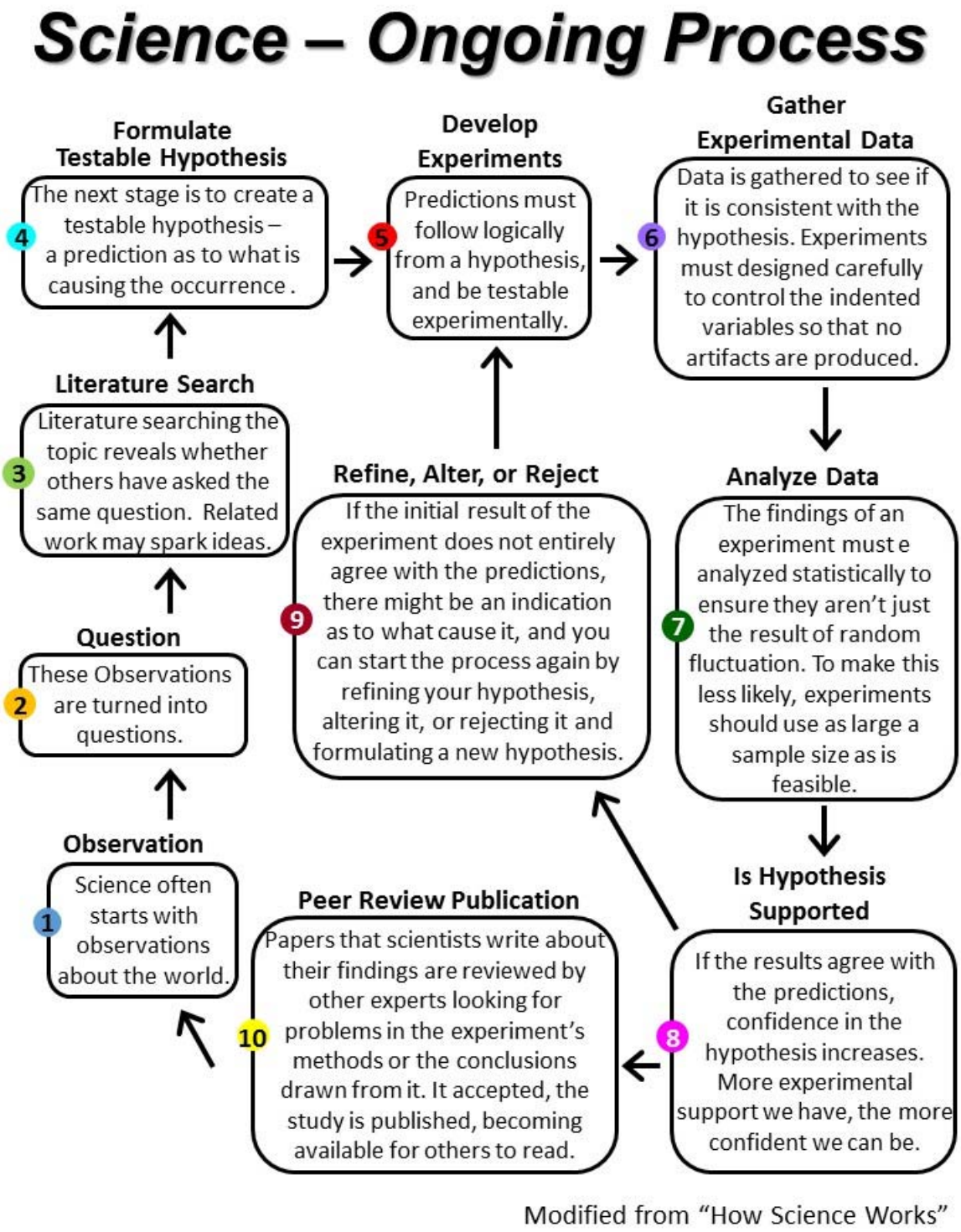

Figure 1 In order to achieve sensible science goal, iterations of science process usually take place.

Table 1 Rubrics for Evaluation of PPTx Presentation

Course: PHYS 102 (CURE/PBL) Evaluation Rubrics of Presentation

Date: **Time:**

5	4	3	2	1
Strongly Agree				Strongly Disagree

	Presentation Trait | Group #	
I	**Quality of Information:** Main points are clear, well-developed, and well supported with evidence; appropriate use of terminology.	
II	**Quality of Orgaization:** Information an ideas are presented in a chronological and logical order; presentation flows well; presentation of information promotes autidence understanding.	
III	**Quality of Communication:** Speaker(s) appears comfortable and confident; speaker shows engaging and inviting presence; speaker's voice is confident, steady, strong, and clear.	
IV	**Visual Tools:** Visual aids (e.g., graphs, diagrams, pictures, etc.) are clear and easy to read and enhance the effectiveness of presentation; imagees have relevance to main ideas.	
V	**Overall Impact:** Information is linked to presentation topic; shows broad impact and significant of their work.	
	Total Score	
	Percentage Score	%