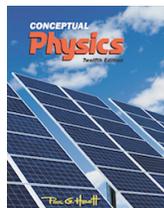


# Teacher's Manual Conceptual Physics 2020 - 2021



Thank you for signing up for Conceptual Physics. You are now looking over the teacher's manual (aka, user's guide) to your Conceptual Academy course. There's a lot to digest, but please understand: This course is truly a guided course. We authors are your tour guides. We know the path rather well having traveled it many times before. You, the teacher, are your student's personal assistant. You are also their coach, cheering them onward and providing personalized help as needed. The purpose of this manual is to provide you, the teacher, a birds-eye view of an amazing adventure that's about to unfold for both yourself and your student. But throughout your journey, for any further support you might need, please write to us at [Support@ConceptualAcademy.com](mailto:Support@ConceptualAcademy.com).

## 1. About Conceptual Physics

This course is divided into *units*, which are divided into *modules*. Each module is designed to take about two weeks to complete with the assumption the student has other courses and extracurricular activities. For this course there are 24 modules spread across 6 units, which is more than enough a full academic year of study. You'll note there's much from the textbook that we don't cover. Please understand that the textbook contains so much content to provide instructors variety. It is typical that the instructor chooses from this library of content to create a syllabus fitting to his or her students. This is what we have done for you with this particular Conceptual Physics course appropriate for a broad range of high school students. If your student is on the ambitious side, we recommend our Conceptual Physics Honors course, which puts the student in the driver's seat as to what gets emphasized.

## 2. Laboratories

Science and experiments go together hand-in-glove. For this Conceptual Academy course you will find all the lab activities have been embedded. These labs are designed to be done with materials readily available in the home or a local discount store. We recommend the student keep a "field journal" to document their experience. Please look to the Doc Share of the first FYI page of the course for details regarding these labs. Each activity begins with a materials list.

You'll find relatively few questions to be graded within the labs. For grading purposes, these few questions can be ignored. Their importance is minor. Instead, the full thrust of

“grading” should be on the quality of the student’s field journal. Toward this you’ll find grading rubrics within the To the Student document. We place it there so that the student can also see what’s expected of them. While early entries might be sloppy and lacking, the goal is to see improvement as the year progresses. Periodically, expect that you’ll need to buckle down on your field journal critiques.

In addition to these lab activities that you’ll find throughout the course, you will also find the “Think and Do” activities found in the textbook. These are easy to perform activities using only household materials. There are about 4 or 5 of these short and sweet activities found at the end of each textbook chapter. Again, the student’s experience with these activities should be recorded in the field journal.

Also, there are about two dozen interactive simulations embedded throughout the course. For some of these simulations you will find a direction sheet within the Doc Share. In the absence of such a direction sheet, we ask that the student simply play around with the simulation. There is value in play.

### **3. Learning Philosophy**

We are advocates of “Step 1/Step 2” learning. Step 1 is where the student is being introduced to material, such as through the textbook and video tutorials. Step 1 is an input process. You’ll note the mouth is closed. “Step 2” is an output process where the student tries to articulate (output) that which they think they learned from Step 1 through activities such as presentations and homework. Of these two steps, Step 2 is arguably the more difficult. Students tend to avoid Step 2 or neglect its importance. Learning, however, is only deep and durable when BOTH Step 1 and Step 2 have been employed. See our “How to Study Effectively” document in the first Doc Share of this course to learn more.

### **4. A Typical Student Day**

Please visit [HomeschoolPlanet.com](http://HomeschoolPlanet.com) where you will find detailed automated planners available for each Conceptual Academy course. The PDF versions of these planners are also available at our homeschool support site: [LearnScience.Academy](http://LearnScience.Academy).

These planners were built by the conceptual authors. Each planner details specific learning activities a student is to accomplish for each day across the entire course. That said, below are the general ideas that went behind the building of these planners.

What should a student’s typical day look like? We find it generally best for the student to begin with a Step 1 activity, such as reading the textbook or watching a video tutorial. After completing each textbook chapter section or video, the student is encouraged to ask themselves a most powerful learning question: “What did I just learn?” and then to answer this very question aloud or in writing. In doing so, the student is interleaving a Step 2 activity within a Step 1 activity, which is most productive.

After working with the textbook and videos, the student should put effort into the “Practice Page” worksheets available from the Doc share within each module.

There are the many end-of-chapter (EOC) questions within the textbook, all of them partitioned by chapter section. These are an important Step 2 activity for the student. Because of their great number, we believe that half of the odd-numbered questions is fairly ambitious. Notably, the student will find the answers to the odd-numbered questions at the back of the book. This is important for the student to be able to confirm their understanding. It's also important that the student try their best to answer the question BEFORE looking at the answer. Any good answer will "make sense" after reading it. But it's not the answer that matters. What counts is being able to come up with the answer on one's own. A good student understands the world of difference between reading an answer and creating that answer him or herself.

Any opportunity the student has to summarize (aloud) what they believe they have learned to classmates, friends, or family members, is a serious bonus to the learning process—on many levels. You should consider the following capstone learning activity: Once a student "completes" a chapter, have the student provide a verbal summary of the main ideas of the chapter. You can call this: "The Summary Challenge". It's not as easy as it might sound, but it's a great way of identifying that which has been retained (or not). The process itself helps to make the learning durable. It's normal for students to stumble as they try their best to articulate what they think they learned. They deserve much credit for putting forth this kind of effort.

Then there are Conceptual Academy's "Homework Practice Sessions", also known as the HPS. The HPS serves a similar purpose to the end-of-chapter questions (Step 2 Learning). The goal is to provide the student ample opportunity to practice that which they think they have learned. As we'll describe shortly, the HPS questions are relatively difficult. Though there can be over 100 questions within a single HPS, the student is expected to study only as many as they can in a single session. Working on 10 to 20 questions in a single sitting is respectable.

In addition to the above activities, there are the labs and the unit exams. Which is to say, there is no shortage of resources available for your student. Success can be had by shifting from one resource to the next. As soon as the student becomes saturated with one activity, then STOP. Move to another activity. Interleave these activities as per the wishes of the student. This is in contrast to a learning system of: "Hey kiddo. Here's the textbook. Now read until you learn something. Then we'll see if you can pass the test." Not good! We know from experience that the key to helping students learn is offering a variety learning resources. Variety is YUM! Let your student's days be filled with variety.

## **5. Grades—Summative and Formative**

In traditional academics, most students are more focused on their letter grade than the actual learning that letter grade is suppose to represent. When scholarships and admissions to competitive colleges are at stake, this is understandable. Ideally, though, a higher letter grade reflects higher learning. But there are all sorts of exceptions. A student who has struggled for a "B" in a subject that is of sincere interest, is more likely to retain

that knowledge over the long term, than a book savvy student who could care less but can still pull an “A”.

We await the day when the standardized “Scholastic Aptitude Test” is replaced with a “Scholastic Attitude Test”. In our experience as college professors, attitude is just as important as aptitude, if not more so.

It’s not until graduate school that many students begin to realize that the whole A|B|C|D|F grade system itself is to be taken with a huge grain of salt. What counts most is the learning, which is closely related to good attitude. But more than mere “knowledge” the ideal goal is nurturing our innate curiosity. Then beyond curiosity, and much more valuable than a perfect SAT score, is helping the student grow into a responsible, well-adjusted, happy, loving, and productive individual who can support him or herself and a family with a career they actually enjoy.

The true value of a grade is not as a final end-all to a particular course of study. Let’s call that a “*summative grade*”. Rather, grades are more important as feedback that helps us learn DURING that course of study. Let’s call this a “*formative grade*”. The value in a formative grade is in the guidance it provides while we still have time to make corrections—to let us know when we’re on track and when we might still be holding onto misconceptions BEFORE the end of the semester.

We here at Conceptual Academy are not in a position to assign a final overall summative grade for each student taking one of our self-study courses. This is the responsibility of the teacher who has been working directly with the student throughout the course of study. We are, however, very much in a position to provide formative grades throughout. This comes in the form of the reading quizzes, the video quizzes, and the HPS as tracked by the Conceptual Academy grade book, as well as the answers to the chapter questions at the back of the textbook, and the answers to the Practice Pages available within the Doc Shares, as well as the answer keys we provide for all unit exams and lab activities. Let’s talk about these components one by one.

### *Reading Quiz*

A set of easy-to-answer questions collated from the chapter sections of each lesson. There is one “lesson reading quiz” for each lesson. These are designed to provide the student credit for having studied the paragraphs of the textbook. In many cases, the question is printed right within the margin of the textbook while the answer is highlighted within the paragraph. The “Reading Check” question at Conceptual Academy is the multiple choice version of that question.

### *Video Quiz*

A set of easy-to-answer questions relating to a particular video. Each video has a video quiz, which consists of one to three questions. These questions focus on the content of the video, which will be similar to the content of the corresponding textbook chapter section. In most cases, a student who has studied the textbook chapter section, may be able to do well with the video quiz without watching the

video. This is by design to minimize any “busy work”. We don’t want the student watching the video if they don’t need to watch the video. Similarly, the student might be able to do well on a lesson reading quiz without reading the textbook but after watching all the videos. Ideally, a student works with both the textbook and the videos, which together provide the student a stereoscopic view of the material.

### *Homework Practice Session (HPS)*

There is one Homework Practice Session (HPS) for each lesson. The HPS is an important Step 2 activity for the student after having studied the reading and video assignments for that lesson. The questions of the HPS are relatively difficult. Plus there are many of these questions—sometimes over 100 in a single session.

The goal of a homework practice session is PRACTICE. We liken it to practicing basketball. While practicing on the court, the basketball player should be taking chances, making mistakes, and learning from those mistakes. While practicing, the player should not be limited in the number of shots they’re allowed to take. Also, the player should only practice for as long as is efficient. Push themselves, yes, but not to the point of exhaustion. When efficiency is lost, it’s best to STOP. Take a break. Come back the next day to practice some more while fresh.

The same holds true for the Homework Practice sessions in which the student is encouraged to take chances, make mistakes, and learn from those mistakes. A session should go for as long as is reasonable for that student, which can vary from day to day. For each correct answer, the student earns 2 points. There’s never a penalty for any wrong answer.

Each question is first presented in a short answer format. The student’s free response is not graded, nor recorded in any database. Rather, it serves as a warm up to the multiple choice version of that question, which comes next.

If a student is averaging about 55% on a set of HPS questions, then this is admirable. It shows they’re trying to answer the question without first looking up the answer. This is to be encouraged. Students should also be encouraged to work with others on these questions, which makes for a good group activity.

### *Points from the Reading and Video Quizzes and the HPS*

For context, you should understand how the reading and video quizzes and the HPS are used at the college level. College students using Conceptual Academy are typically told they need to collect a certain number of CA points by the end of the semester. How many points depends upon the needs of the course, where 800 is a typical number. For such a course, all students who acquire at least 800 points will earn a 100% on this assignment, which counts for about 20% of their total summative letter grade. In this scenario, students aren’t penalized for wrong answers. They just need to keep answering questions until they earn these 800 points. We call this an “encouragement-based approach” such that Conceptual Academy is there to reward students for good study habits.

So, in the college scenario, you've got one instructor with potentially 100+ students. For a self-study course where the student teacher ratio is closer to 1:1, then there's opportunity to take it to the next level. We suggest requiring your student to earn in the area of 1500 points by the end of the course, but paced along the way by having thresholds they must meet for each unit.

For this Conceptual Physics course, we recommend the following per unit grading scheme for the automated quizzes at Conceptual Academy:

### Per Unit Grading for the Automated Quizzes

<i>Metal Status</i>	<i>Points to Qualify</i>	<i>Points Earned</i>	<i>Grade</i>
Supernova	350		Advance by another metal in another unit
Platinum	300		Advance by one metal in another unit
<b>Gold</b>	<b>250</b>		"A" work
Silver	200		"B" work
Bronze	150		"C" work
Copper	100		"D" work
Aluminum	50		Developing

The student works their way up from one "metal status" to the next. Their goal is to reach the gold status for full credit "A" level work. Each subsequent level they might reach (platinum and supernova) allows them to advance by one metal status in another unit where they might be shy in points earned.

The particular numbers in the above chart were derived from several considerations. First, the gold level is comparable to what diligent college students earn across the many college campuses using Conceptual Academy. Second, our experience with homeschools is that this 250 point unit threshold is an admirable level. Even more admirable is when the student maintains that gold level status throughout the entire course. Third, we have tabulated the number of actual points available for each unit for this course as follows:

All Units	Unit A	Unit B	Unit C	Unit D	Unit E	Unit F
3788	630	802	922	578	292	564

There are well over 250 points available for each unit. This translates into ample opportunity for the student as well as a fair amount of flexibility. Remember, the goal with these automated quizzes is not to assess what students have learned, but to provide credit for their time on task learning. It's quite possible, and even likely, that your student will far exceed the 250 point threshold for any particular unit. This, in turn, will give them credit for achieving gold status for Unit E, which has the lowest number of points possible.

In assigning a final summative letter grade, we recommend the student's Conceptual Academy score from the video, reading, and HPS questions (combined) should be worth from 20% to 40% of the overall course grade. The remaining portion of the overall course grade should be from the lab activities, unit exams, and any special projects.

### *End-of-Chapter Questions*

Most of the questions at the back of each textbook chapter are presented in the short answer format. But which ones should your student answer? Here's a good rule of thumb: Every other odd-numbered question is relatively ambitious. You'll note that the questions start out easy, then build in difficulty level. We feel the "Think and Explain" questions are of most value.

Now, "how" should your student answer these questions? Think of these questions as conversation starters. Ideally, the student has some one they can explain their thoughts to verbally. There's a discussion that leads to an agreement. Only then is the answer looked up in the back of the book. The student might rate themselves as to the quality of their initial answer on a scale of 1 through 5. At that point most students would just move onto the next question. We have a better alternative: Now that the student has been exposed to the "real answer", have them explain it again (without looking at the answer). Then they rate again on a scale of 1 through 5. You'll see what's happening here is the student is articulating. As this is done, there are pathways within the brain that are literally being built. Durable learning is occurring. It requires effort. No one is exempt. It can be tiring. What to do when the student gets exhausted and feels like a sponge with all the water squeezed out of it? Answer: Stop! Do something else. Some physical activity. Or study another subject, such as history. Or just take a break.

You should see that all the end-of-chapter questions are quite the resource for Step 2 learning. But how to grade their performance on these questions? The answer is: don't. Learning is still occurring. No grading please. But you might consider setting a goal for the number of questions worked upon. For example, 10 questions. Dear student: Get through 10 questions and you'll have earned yourself a sticker, or better yet, a chocolate bar. Ultimately, the student should recognize that working on these EOC questions is great preparation for the unit exam. But beyond that, learning is its own reward. If all students could be brought to this understanding, we believe the bulk of problems in our nation's education system would melt away.

### *Practice Page Worksheets*

These are pencil-pushing minds-on activities. In a way, they are similar to a lab experience, except it's all on paper. Our goal in creating these Practice Pages is to provide an enjoyable venue through which the student can *apply* what they think they understand. Please note: It's not like the student already understands something and then should be able to do the worksheet. It's the other way around. The understanding evolves only when the student is working on the worksheet.

This is similar to the end-of-chapter questions. The student may ask: How can I answer these questions if I don't first understand the material? They have it backward. The real question is: How can you understand the material if you don't first work on these questions? The understanding itself arises from working on the questions. After Step 1? After reading the book and watching the videos? The student may feel they still don't really understand. That's correct. That's a wise student! An even wiser student knows that the understanding will grow like a seed from the soil only when watered by a stream of well-placed questions (Step 2). We call this "formative".

### *Unit Exams*

Our unit exams can be considered a blend of both formative and summative grading, but with an emphasis on the formative. They are each presented in what at first seems like an unusual and complicated format, we call the "pyramid" format. But once you've been introduced to this format, you'll see it as a great learning opportunity. And fun too!

You'll find the pdf for each unit exam in the Doc Share on the last FYI page of each unit. Unlike the quizzes, and much like the Practice Pages, these are to be printed out. You'll find each exam begins with directions on how to run the exam in the pyramid format. Keep in mind that this format requires relatively tough level 3 questions. Your student is doing well upon earning around 60% on the first round. On subsequent rounds, this score will improve dramatically. It's important that students know of this design. Again, a 60% on round one is to be applauded.

In assigning a final summative grade, performance on these unit exams should hold some weight. For college students, their exams typically account from 50% to 80% of their course grade (lecture component). But for this course, there are only six unit exams across the entire academic year. We suggest that the unit exam counts for around 20% of the overall grade for a particular unit. But we also suggest that you trust your own judgment for your own particular situation.

In our minds, if a student is doing all the work and has a good command over the material as evidenced by their ability to articulate that which they think they understand, then that qualifies as excellent. Attitude is everything.

### *Lab Activities*

Many colleges still follow a 3:1 credit system, whereby the student earns 3 credit hours for "lecture" and 1 credit hour for "laboratory". On some campuses the student earns a single grade for both lab/lecture. At other campuses, the grade for lecture and lab are recorded separately. So, one way or the other, the lab component counts for about 25% of the overall assessment. It is typical that a student's lab scores tend to lift their lecture scores, which are based primarily on the mid-term exams as described above.

For your Conceptual Academy course, we recommend the same kind of balance. Ideally, the hands-on “experiential” lab activities are there to complement the more minds-on process of learning concepts. The two work together. Relative to a grade, consider granting your student 50% just for completing a lab activity. You might then consider the remaining 50% on the quality of a student’s writing or their answers to questions as evidenced from their field journal. Toward this, we have provided lab activity grading rubrics (See the first Doc Share of the course)

### *Next-Time Questions*

We see these as “conceptual” flash cards. No grading. But they can be posted for the whole family to see and consider. The discussions that follow are that little something extra adding value to the student’s learning experience.

On a final note, the course concludes with a downloadable, high-resolution Certificate of Completion, pre-signed by the author and awaiting the signature of the student’s mentor.



## **6. Putting It All Together**

In addition to the textbook, our library of video lessons (integrated with the textbook), the automated quizzes, the HPS, the Practice Pages, the unit exams, you will also find study advice from the author on each FYI page, interactive simulations, plus a number of Easter egg surprises spiced here and there. And for technical support, please write to [Support@ConceptualAcademy.com](mailto:Support@ConceptualAcademy.com).

We know you will find this self-study course to be rich not only in content but in flavor. Our goals go beyond imparting knowledge. We aim to nurture a life-long curiosity about this amazing natural world in which we are blessed to live. We know this to be an important path to becoming good stewards. Further, the rules of nature are what we all have in common and as this world gets smaller, a focus on what we have in common becomes all the more important. Further still, understanding science for what it is, for

what it can do, for what it can't do, for how it, for better or worse, has impacted our daily lives, is critically important for any student in this modern age.

Thank you for your support of Conceptual Academy. We are so please and honored to be working with you.

Good science to you!

The Conceptual Academy Team



Prof. Hewitt  
Geology



Prof. Suchocki  
Chemistry & Astro



Prof. Hewitt  
Physics



Prof. Lyons  
Earth Science



Prof. Yeh  
Biology

## **7. But wait, there's more! The Log/Planner Sheets**

What follows is the table of contents of this course that you might use as a log sheet to chart student progress and to demonstrate to any college admissions officer the college level quality of the chemistry course taken by your student.

To take planning to an even higher level, we have also created our planners now available at [HomeschoolPlanet.com](http://HomeschoolPlanet.com) fitting into their slick automated system. These planners were built by us conceptual authors. Each planner details specific learning activities a student is to accomplish for each day across the entire course. For just PDFs of these planners that you might print and post on the refrigerator, please visit our homeschool support site [www.LearnScience.Academy](http://www.LearnScience.Academy).

## Syllabus: Conceptual Physics

Log Sheet (Completion Date)

### Unit : A : Mechanics

#### Unit A Grading

<i>Metal Status</i>	<i>Points to Qualify</i>	<i>Points Earned</i>	<i>Grade</i>
Supernova	350		Advance by another metal in another unit
Platinum	300		Advance by one metal in another unit
<b>Gold</b>	<b>250</b>		"A" work
Silver	200		"B" work
Bronze	150		"C" work
Copper	100		"D" work
Aluminum	50		Developing

#### Module 1 ( / / )

FYI page

1.1 Scientific Measurements

1.2 Scientific Methods

1.3 Science, Art, and Religion

1.4 Science and Technology

1.5 Physics - The Basic Science

1.6 In Perspective

Module Reading Quiz

Homework Practice Session

#### Module 2 ( / / )

FYI page

2.1 Aristotle on Motion

2.2 Galileo's Experiments

2.3 Newton's First Law of Motion

2.4 Net Force and Vectors

2.5 The Equilibrium Rule

2.6 Support Force

2.7 Equilibrium of Moving Things

2.8 The Moving Earth

Module Reading Quiz

Homework Practice Session

#### Module 3 ( / / )

FYI page

3.1 Motion is Relative

3.2 Speed

3.3 Velocity  
 3.4 Acceleration  
 3.5 Free Fall  
 3.6 Velocity Vectors  
 Module Reading Quiz  
 Homework Practice Session

**Module 4 ( / / )**

FYI page  
 4.1 Force Causes Acceleration  
 4.2 Friction  
 4.3 Mass and Weight  
 4.5 When Acceleration Is  $g$ --Free Fall  
 4.6 When Acceleration Is Less Than  $g$ --Nonfree Fall  
 4.4 Newton's Second Law of Motion  
 Module Reading Quiz  
 Homework Practice Session

**Module 5 ( / / )**

FYI page  
 5.1 Forces and Interactions  
 5.2 Newton's Third Law of Motion  
 5.5 Summary of Newton's Three Laws  
 5.4 Vectors and the Third Law  
 5.3 Action and Reaction on Different Masses  
 Module Reading Quiz  
 Homework Practice Session

**Unit : B: Energy and Gravity**

**Unit B Grading**

<i>Metal Status</i>	<i>Points to Qualify</i>	<i>Points Earned</i>	<i>Grade</i>
Supernova	350		Advance by another metal in another unit
Platinum	300		Advance by one metal in another unit
<b>Gold</b>	<b>250</b>		"A" work
Silver	200		"B" work
Bronze	150		"C" work
Copper	100		"D" work
Aluminum	50		Developing

**Module 1 ( / / )**

FYI page  
 6.1 Momentum  
 6.2 Impulse

6.3 Impulse changes Momentum  
6.4 Bouncing  
6.5 Conservation of Momentum  
6.6 Collisions  
6.7 More Complicated Collisions  
Module Reading Quiz  
Homework Practice Session

**Module 2 ( / / )**

FYI page  
7.1 Work  
7.2 Potential Energy  
7.3 Kinetic Energy  
7.5 Conservation of Energy  
7.6 Machines  
7.7 Efficiency  
7.8 Sources of Energy  
7.4 Work-Energy Theorem  
Module Reading Quiz  
Homework Practice Session

**Module 3 ( / / )**

FYI page  
9.1 The Universal Law of Gravity  
9.2 The Universal Gravitational Constant, G  
9.3 Gravity and Distance: The Inverse-Square Law  
9.4 Weight and Weightlessness  
9.5 Ocean Tides  
9.6 Gravitational Fields  
9.8 Universal Gravitation  
9.7 Black Holes  
Module Reading Quiz  
Homework Practice Session

**Module 4 ( / / )**

FYI page  
10.1 Projectile Motion  
10.2 Fast-Moving Projectiles--Satellites  
10.3 Circular Satellite Orbits  
10.4 Elliptical Orbits  
10.5 Kepler's Laws of Planetary Motion  
10.6 Energy Conservation and Satellite Motion  
10.7 Escape Speed  
Module Reading Quiz  
Homework Practice Session

## Unit : C: Matter and Heat

### Unit C Grading

<i>Metal Status</i>	<i>Points to Qualify</i>	<i>Points Earned</i>	<i>Grade</i>
Supernova	350		Advance by another metal in another unit
Platinum	300		Advance by one metal in another unit
<b>Gold</b>	<b>250</b>		"A" work
Silver	200		"B" work
Bronze	150		"C" work
Copper	100		"D" work
Aluminum	50		Developing

### Module 1 ( / / )

FYI page

11.1 The Atomic Hypothesis

11.2 Characteristics of Atoms

11.4 Atomic Structure

11.6 Isotopes

12.2 Density

12.4 Tension and Compression

12.5 Arches

12.6 Scaling

Module Reading Quiz

Homework Practice Session

### Module 2 ( / / )

FYI page

13.1 Pressure

13.2 Pressure in a Liquid

13.3 Buoyancy

13.4 Archimedes' Principle

13.5 What Makes an Object Sink or Float?

13.6 Flotation

13.7 Pascal's Principle

Module Reading Quiz

Homework Practice Session

### Module 3 ( / / )

FYI page

14.1 The Atmosphere

14.2 Atmospheric Pressure

14.3 Boyle's Law

14.4 Buoyancy of Air

14.5 Bernoulli's Principle  
14.6 Plasma  
Module Reading Quiz  
Homework Practice Session

**Module 4 ( / / )**

FYI page  
15.1 Temperature  
15.2 Heat  
15.3 Specific Heat Capacity  
15.4 The High Specific Heat Capacity of Water  
15.5 Thermal Expansion  
Module Reading Quiz  
Homework Practice Session

**Module 5 ( / / )**

FYI page  
16.1 Conduction  
16.2 Convection  
16.3 Radiation  
16.4 Newton's Law of Cooling  
16.7 Solar Power  
16.8 Controlling Heat Transfer  
17.1 Phases of Matter  
17.2 Evaporation  
17.3 Condensation  
Module Reading Quiz  
Homework Practice Session

**Unit : D: Electromagnetism**

**Unit D Grading**

<i>Metal Status</i>	<i>Points to Qualify</i>	<i>Points Earned</i>	<i>Grade</i>
Supernova	350		Advance by another metal in another unit
Platinum	300		Advance by one metal in another unit
<b>Gold</b>	<b>250</b>		"A" work
Silver	200		"B" work
Bronze	150		"C" work
Copper	100		"D" work
Aluminum	50		Developing

**Module 1 ( / / )**

FYI page

22.1 Electricity

22.2 Electric Charges

22.3 Conservation of Charge

22.4 Coulomb's Law

22.5 Conductors and Insulators

22.6 Charging

22.7 Charge Polarization

22.8 Electric Field

22.9 Electric Potential

Module Reading Quiz

Homework Practice Session

**Module 2 ( / / )**

FYI page

23.1 Flow of Charge and Electric Current

23.2 Voltage Sources

23.3 Electrical Resistance

23.4 Ohm's Law

23.5 Direct Current and Alternating Current

23.6 Speed and Source of Electrons in a Circuit

23.7 Electric Power

23.8 Lamps

23.9 Electric Circuits

Module Reading Quiz

Homework Practice Session

**Module 3 ( / / )**

FYI page

24.1 Magnetism

24.9 Biomagnetism

24.2 Magnetic Poles

24.3 Magnetic Fields

24.4 Magnetic Domains

24.5 Electric Currents and Magnetic Fields

24.6 Electromagnets

24.7 Magnetic Forces

24.8 Earth's Magnetic Field

Module Reading Quiz

Homework Practice Session

**Module 4 ( / / )**

FYI page

25.1 Electromagnetic Induction

25.2 Faraday's Law

25.3 Generators and Alternating Current  
 25.4 Power Production  
 25.6 Self-Induction  
 25.7 Power Transmission  
 25.8 Field Induction  
 25.5 Transformers  
 Module Reading Quiz  
 Homework Practice Session

**Unit : E: Sound and Waves**

**Unit E Grading**

<i>Metal Status</i>	<i>Points to Qualify</i>	<i>Points Earned</i>	<i>Grade</i>
Supernova	350		Advance by another metal in another unit
Platinum	300		Advance by one metal in another unit
<b>Gold</b>	<b>250</b>		"A" work
Silver	200		"B" work
Bronze	150		"C" work
Copper	100		"D" work
Aluminum	50		Developing

**Module 1 ( / / )**

FYI page  
 19.1 Good Vibrations  
 19.2 Wave Description  
 19.3 Wave Motion  
 19.4 Wave Speed  
 19.5 Wave Interference  
 19.6 Doppler Effect  
 19.7 Bow Waves  
 19.8 Shock Waves  
 Module Reading Quiz  
 Homework Practice Session

**Module 2 ( / / )**

FYI page  
 20.1 Nature of Sound  
 20.2 Sound in Air  
 20.3 Reflection of Sound  
 20.4 Refraction of Sound  
 20.5 Forced Vibrations  
 20.6 Resonance  
 20.7 Interference

20.8 Beats  
Module Reading Quiz  
Homework Practice Session

**Module 3 ( / / )**

FYI page  
21.1 Noise and Music  
21.2 Pitch  
21.3 Sound Intensity and Loudness  
21.4 Quality  
21.5 Musical Instruments  
21.6 Fourier Analysis  
21.7 From Analog to Digital  
Module Reading Quiz  
Homework Practice Session

**Unit : F: Light**

**Unit F Grading**

<i>Metal Status</i>	<i>Points to Qualify</i>	<i>Points Earned</i>	<i>Grade</i>
Supernova	350		Advance by another metal in another unit
Platinum	300		Advance by one metal in another unit
<b>Gold</b>	<b>250</b>		"A" work
Silver	200		"B" work
Bronze	150		"C" work
Copper	100		"D" work
Aluminum	50		Developing

**Module 1 ( / / )**

FYI page  
26.1 Electromagnetic Waves  
26.3 The Electromagnetic Spectrum  
26.4 Transparent Materials  
26.5 Opaque Materials  
26.6 Seeing Light - The Eye  
26.2 Electromagnetic Wave Velocity  
Module Reading Quiz  
Homework Practice Session

**Module 2 ( / / )**

FYI page  
27.1 Color in Our World  
27.2 Selective Reflection

27.3 Selective Transmission  
27.4 Mixing Colored Lights  
27.5 Mixing Colored Pigments  
27.6 Why the Sky Is Blue  
27.7 Why Sunsets Are Red  
27.8 Why Clouds Are White  
27.9 Why Water Is Greenish Blue  
Module Reading Quiz  
Homework Practice Session

**Module 3 ( / / )**

FYI page  
28.1 Reflection  
28.2 Law of Reflection  
28.8 Lens Defects  
28.3 Refraction  
28.4 Cause of Refraction  
28.5 Dispersion and Rainbows  
28.6 Total Internal Reflection  
28.7 Lenses  
29.1 Huygens' Principle  
29.5 Polarization  
29.6 Holography  
Module Reading Quiz  
Homework Practice Session