

**Teacher's Manual**  
**Conceptual Integrated Science — The Full Version**  
*2020 – 2021*



Thank you for signing up for Conceptual Integrated Science—Full Version. 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 Integrated Science, Full Version**

This course is divided into 5 *units*, which are divided into *modules*. Each module is designed to take about two weeks to complete with the assumption that the student has other courses and extracurricular activities. For this course there are 29 modules, where each module corresponds to a textbook chapter. This is ample for two years of study. Year 1: Physics and Chemistry. Year 2: Biology, Earth Science, and Astronomy. We say this course is “integrated” in that we bring forward applications of one area of science while discussing another. For example, in describing the physics of light, we show how this applies to the inner workings of our eyes, which, in turn, are sensitive to visible light in great part because of the chemical composition of our atmosphere.

Please note, our 3<sup>rd</sup> edition of the CIS textbook was published summer 2019 with numerous content updates. However, you'll find the older 2<sup>nd</sup> edition will work just as well for this particular course. To accommodate the two editions, we have produced two Homeschool Planet planners for this one course—one to use with the second edition textbook and another to use with the third edition textbook.

You'll find each module packed with activities, both minds-on and hands-on. This is just the nature of this course, which aims to cover much. . . physics, chemistry, biology, Earth science, astronomy, which means a great assortment of activities. In the end, you'll find this course makes for a good introduction to each of these fields. Greater depth can then be accomplished in a by taking one of our more specific courses now available in physics and chemistry.

## 2. Laboratories

Ample laboratory activities are posted right within the modules. You need not purchase any mail-order lab kit. Instead, the materials for these activities, such as white glue, coins, and popsicle sticks, are readily available within your household or a discount store. You'll find these lab activities to be substantial and meaningful allowing the student to apply the concepts of integrated science, which is an essential part of the learning cycle. These lab activities are collated from the following sources:

- 1) You'll find the "Think and Do" activities described within the textbook end-of-chapter material. These activities tend to be short and sweet, as well as numerous.
- 2) We offer "PhET Labs" that make use of interactive simulations created through the PhET program sponsored by the University of Colorado. The PhET simulations themselves are embedded within a module's From Your Instructor (FYI) page. For many of these simulations you'll also find within the Doc Share a write-up worksheet that guides the student through a simulation-based activity.
- 3) Select lab experiments were adapted from our *Course Guide Book* manuals for Conceptual Physics and Conceptual Chemistry by professors Stephanie Blake of Ozarks Technical College and Brandon Burnett of Weber State University.
- 4) Our *Conceptual Integrated Science Lab Manual* contains about 100 activities, which is way too many for any self-study course. So, in addition to the above mentioned activities, we have narrowed this down to a lab for each module. You'll find these with the Doc Share of the FYI page of each module. Like the other lab activities listed above, these too require materials that should be readily available. For example, to measure a star's ascension, you need only a straw, protractor, pencil, and a weighted string.

## 3. Learning Philosophy

We are strong proponents of "interleaving", which means a student undertakes a series of shorter study sessions on different subjects rather than one long study session on a single subject. For example, the student might spend an hour studying chemistry, followed by a history lesson. Interestingly, as the student is then studying history, the chemistry lesson remains brewing at a deeper level—and vice versa with history as the student turns back to the chemistry.

We are also 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 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. 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 automated 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 lesson.

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. You'll find a great number of EOC questions to provide variety. How many should be worked upon? About ten is a reasonable. It's also important that the student try their best to come up with an answer on their own BEFORE looking at the author's 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.

Then there are Conceptual Academy's "Homework Practice Sessions", otherwise 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 kid. 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 typical day 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 grad 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 module. There is one “module reading quiz” for each module. 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, which 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 are not 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. Indeed, across campuses, large and small, we find about two thirds of all students meet or far exceed their point threshold by the end of the course.

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, which means requiring your student to earn 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 Integrated Science 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           | 400                      |                      | Advance by another metal in another unit |
| Platinum            | 350                      |                      | Advance by one metal in another unit     |
| <b>Gold</b>         | <b>300</b>               |                      | "A" work                                 |
| Silver              | 250                      |                      | "B" work                                 |
| Bronze              | 200                      |                      | "C" work                                 |
| Copper              | 150                      |                      | "D" work                                 |
| Aluminum            | 100                      |                      | 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 300 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:

|                  |        |        |        |        |        |
|------------------|--------|--------|--------|--------|--------|
| <b>All Units</b> | Unit A | Unit B | Unit C | Unit D | Unit E |
| <b>7502</b>      | 2062   | 2698   | 664    | 1502   | 576    |

There are well over 300 points available for each unit. This translates into ample opportunity for the student as well as a fair amount of flexibility. The student could random guess nearly every answer and still earn gold metal status. We expect, however, that all students come to understand that an honest effort is much more rewarding as well as efficient. 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 that your student will far exceed the 300 point threshold for any particular unit.

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 very ambitious. Keep it to a few questions per section so that the task is not arduous. 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? Why not some physical activity or even 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. For that, you can rely on the HPS. 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 two unit exams during Year 1 and only three unit exams during Year 2. 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 judgement 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 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 75% just for completing a lab activity. You might then nit-pick the remaining 25% on the quality of a student's writing or their answers to questions.

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 or planner to chart student progress and to demonstrate to any college admissions officer the college-prep level quality of the science course taken by your student.

Please note that the syllabus your student follows at Conceptual Academy is itself a planner. For each lesson, you'll find the chapter sections to be studied, videos to be watch, simulations to be played with, and documents to be downloaded all on an as needed basis.

To take planning to an even higher level, please visit [HomeschoolPlanet.com](http://HomeschoolPlanet.com) where you will find detailed automated planners available for each Conceptual Academy course. Each planner details specific learning activities a student is to accomplish for each day across the entire course.

## Syllabus: Conceptual Integrated Science (Full Version)

Log Sheet (Completion Date)

### Unit : A: Physics

#### Unit A Grading

| <i>Metal<br/>Status</i> | <i>Points<br/>to Qualify</i> | <i>Points<br/>Earned</i> | <i>Grade</i>                             |
|-------------------------|------------------------------|--------------------------|--|
| Supernova               | 400                          |                          | Advance by another metal in another unit |
| Platinum                | 350                          |                          | Advance by one metal in another unit     |
| <b>Gold</b>             | <b>300</b>                   |                          | "A" work                                 |
| Silver                  | 250                          |                          | "B" work                                 |
| Bronze                  | 200                          |                          | "C" work                                 |
| Copper                  | 150                          |                          | "D" work                                 |
| Aluminum                | 100                          |                          | Developing                               |

#### Lesson 1 ( / / )

- FYI page
- 1.1 A Brief History of Advances in Science
- 1.2 Mathematics and Conceptual Integrated Science
- 1.3 The Scientific Method--a Classic Tool
- 1.4 The Scientific Hypothesis
- 1.5 The Scientific Experiment
- 1.6 Facts, Laws, and Theories
- 1.7 Science Has Limitations
- 1.8 Science, Art, and Religion
- 1.9 Technology: The Practical Use of Science
- 1.10 The Natural Sciences: Physics, Chemistry, Biology, Earth Science, and Astronomy
- 1.11 Integrated Science
- 1.A An Investigation of Sea Butterfiles
- Lesson Reading Quiz
- Homework Practice Session

#### Document Share

CISPhysPPAnsOpt.pdf

CIS01PhysPP.pdf

AboutSciNTQ.pdf

StudyEffectively5.pdf

AboutCISFull2020.pdf

RubberBandBalance.pdf

## Lesson 2 ( / / )

- FYI page
- 2.1 Aristotle on Motion
- 2.2 Galileo's Concept of Inertia
- 2.3 Mass--A Measure of Inertia
- 2.4 Forces
- 2.5 The Equilibrium Rule
- 2.6 Support Force
- 2.7 Equilibrium of Moving Things
- 2.8 The Force of Friction
- 2.A Friction Is Universal
- 2.9 Speed and Velocity
- 2.10 Acceleration
- 2.B Hang Time
- Lesson Reading Quiz
- Homework Practice Session

### Document Share

CIS02PhysPP.pdf

NewtonFirstNTQ.pdf

PeanutButterJar.pdf

## Lesson 3 ( / / )

- FYI page
- 3.1 Newton's First Law of Motion
- 3.2 Newton's Second Law of Motion
- 3.A Gliding
- 3.3 Forces and Interactions
- 3.4 Newton's Third Law of Motion
- 3.B Animal Locomotion
- 3.5 Vectors
- 3.6 Summary of Newton's Laws
- Lesson Reading Quiz
- Homework Practice Session

PhET: Forces and Motion

### Document Share

CatapultOpt.pdf

CIS03PhysPP.pdf

NewtonSecondNTQ.pdf

NewtonThirdNTQ.pdf

## Lesson 4 ( / / )

- FYI page
- 4.1 Momentum
- 4.2 Impulse
- 4.3 Impulse-Momentum Relationship
- 4.A The Impulse-Momentum Relationship in Sports
- 4.4 Conservation of Momentum
- 4.5 Energy
- 4.6 Power
- 4.7 Potential Energy
- 4.8 Kinetic Energy
- 4.9 The Work-Energy Theorem
- 4.10 Conservation of Energy
- 4.B Glucose: Energy for Life
- 4.11 Machines
- Lesson Reading Quiz
- Homework Practice Session

PhET: Energy Skate Park

### Document Share

BounceOpt.pdf

CIS04PhysPP.pdf

MomentumNTQ.pdf

EnergyNTQ.pdf

EasyLiftingCIS.pdf

## Lesson 5 ( / / )

- FYI page
- 5.1 The Legend of the Falling Apple
- 5.2 The Fact of the Falling Moon
- 5.3 Newton's Law of Universal Gravitation
- 5.A Your Biological Gravity Detector
- 5.4 Gravity and Distance: The Inverse-Square Law
- 5.5 The Universal Gravitational Constant
- 5.6 Weight and Weightlessness
- 5.B Center of Gravity of People
- 5.7 Gravity Can Be a Centripetal Force
- 5.8 Projectile Motion
- 5.9 Projectile Altitude and Range
- 5.10 The Effect of Air Drag on Projectiles
- 5.11 Fast-Moving Projectiles-Satellites
- 5.12 Elliptical Orbits
- 5.C Escape Speed
- Lesson Reading Quiz
- Homework Practice Session

PhET: Gravity and Orbits

**Document Share**

BallDropOpt.pdf

BottleDropOpt.pdf

CIS05PhysPP.pdf

GravityNTQ.pdf

**Lesson 6 ( / / )**

- FYI page
- 6.1 The Kinetic Molecular Theory of Matter
- 6.2 Temperature
- 6.3 Absolute Zero
- 6.4 What Is Heat?
- 6.5 The Laws of Thermodynamics
- 6.A Entropy: The Universal Tendency Toward Disorder
- 6.6 Specific Heat Capacity
- 6.B The Specific Heat Capacity of Water Affects Global Temperature
- 6.7 Thermal Expansion
- 6.10 Heat Transfer: Radiation
- 6.8 Heat Transfer: Conduction
- 6.9 Heat Transfer: Convection
- Lesson Reading Quiz
- Homework Practice Session

PhET: States of Matter

**Document Share**

AbsoluteZero.pdf

CIS06PhysPP.pdf

ThermoNTQ.pdf

EntropyCIS.pdf

**Lesson 7 ( / / )**

- FYI page
- 7.1 Electric Force and Charge
- 7.2 Coulomb's Law
- 7.3 Electric Field
- 7.4 Electric Potential
- 7.5 Conductors and Insulators
- 7.6 Voltage Sources
- 7.7 Electric Current
- 7.8 Electrical Resistance
- 7.9 Ohm's Law

- 7.10 Electric Circuits
- 7.A Electric Shock
- 7.11 Electric Power
- 7.12 The Magnetic Force
- 7.13 Magnetic Fields
- 7.B Earth's Magnetic Field and the Ability of Organisms to Sense It
- 7.14 Magnetic Forces on Moving Charges
- 7.15 Electromagnetic Induction
- Lesson Reading Quiz
- Homework Practice Session

PhET: Charge and Fields

PhET: Balloons and Static Electricity

### **Document Share**

WaterBenderOpt.pdf

MotorOpt.pdf

CIS07PhysPP.pdf

ElectricNTQ.pdf

MagnetNTQ.pdf

### **Lesson 8 ( / / )**

- FYI page
- 8.1 Vibrations and Waves
- 8.2 Wave Motion
- 8.3 Transverse and Longitudinal Waves
- 8.4 The Nature of Sound
- 8.A Sensing Pitch
- 8.5 Resonance
- 8.6 The Nature of Light
- 8.7 Reflection
- 8.8 Transparent and Opaque Materials
- 8.9 Color
- 8.B Mixing Colored Lights
- 8.10 Refraction
- 8.11 Diffraction
- 8.12 Interference
- 8.13 The Doppler Effect
- 8.C The Doppler Shift and the Expanding Universe
- 8.14 The Wave-Particle Duality
- Lesson Reading Quiz
- Homework Practice Session

PhET: Color Vision

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## Unit : B: Chemistry

### Unit B Grading

| <i>Metal<br/>Status</i> | <i>Points<br/>to Qualify</i> | <i>Points<br/>Earned</i> | <i>Grade</i>                             |
|-------------------------|------------------------------|--------------------------|--|
| Supernova               | 400                          |                          | Advance by another metal in another unit |
| Platinum                | 350                          |                          | Advance by one metal in another unit     |
| <b>Gold</b>             | <b>300</b>                   |                          | "A" work                                 |
| Silver                  | 250                          |                          | "B" work                                 |
| Bronze                  | 200                          |                          | "C" work                                 |
| Copper                  | 150                          |                          | "D" work                                 |
| Aluminum                | 100                          |                          | Developing                               |

### Lesson 1 ( / / )

- FYI page
- 9.A Atoms Are Ancient and Empty
- 9.1 The Elements
- 9.2 Protons and Neutrons
- 9.3 The Periodic Table
- 9.B Physical and Conceptual Models
- 9.4 Identifying Atoms Using the Spectroscope
- 9.5 The Quantum Hypothesis
- 9.6 Electron Waves
- 9.7 The Noble Gas Shell Model
- Lesson Reading Quiz
- Homework Practice Session

PhET: Build an Atom

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## Lesson 2 ( / / )

- FYI page
- 10.1 Radioactivity
- 10.A Radiation Dosage
- 10.2 The Strong Nuclear Force
- 10.3 Half-Life and Transmutation
- 10.B Radiometric Dating
- 10.4 Nuclear Fission
- 10.5 Mass-Energy Equivalence
- 10.C Nuclear Fusion
- Lesson Reading Quiz
- Homework Practice Session

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SaferReactors.pdf

## Lesson 3 ( / / )

- FYI page
- 11.1 Chemistry: The Central Science
- 11.2 The Submicroscopic View of Matter
- 11.3 Phase Changes
- 11.4 Physical and Chemical Properties
- 11.5 Determining Physical and Chemical Changes
- 11.6 Elements to Compounds
- 11.7 Naming Compounds
- 11.A The Advent of Nanotechnology
- Lesson Reading Quiz
- Homework Practice Session

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#### Lesson 4 ( / / )

- FYI page
- 12.1 Electron-Dot Structures
- 12.2 The Ionic Bond
- 12.A Metals from Earth
- 12.3 The Covalent Bond
- 12.4 Polar Covalent Bonds
- 12.5 Molecular Polarity
- 12.6 Molecular Attractions
- 12.B Mixtures
- 12.7 Describing Solutions
- 12.8 Solubility
- Lesson Reading Quiz
- Homework Practice Session

PhET: Molecular Shapes

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SolutionsNTQ.pdf

#### Lesson 5 ( / / )

- FYI page
- 13.1 Chemical Equations
- 13.2 Energy and Chemical Reactions
- 13.3 Reaction Rates
- 13.A Catalysts (Earth Science, Biology)
- 13.4 Acids Donate Protons; Bases Accept Them
- 13.5 Acidic, Basic, and Neutral Solutions
- 13.B Acid Rain
- 13.6 Losing and Gaining Electrons
- 13.C Batteries and Fuel Cells (Physics)
- 13.7 Corrosion and Combustion
- Lesson Reading Quiz
- Homework Practice Session

PhET: Balancing Equations

PhET: Acid-Base Solutions

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AcidsNTQ.pdf

### Lesson 6 ( / / )

- FYI page
- 14.1 Hydrocarbons
- 14.2 Unsaturated Hydrocarbons
- 14.3 Functional Groups
- 14.4 Alcohols, Phenols, and Ethers
- 14.5 Amines and Alkaloids
- 14.6 Carbonyl Compounds
- 14.A Drug Action
- 14.7 Polymers
- Lesson Reading Quiz
- Homework Practice Session

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CISChemExUnitB.pdf

## Unit : C: Biology

### Unit C Grading

| <i>Metal<br/>Status</i> | <i>Points<br/>to Qualify</i> | <i>Points<br/>Earned</i> | <i>Grade</i>                             |
|-------------------------|------------------------------|--------------------------|--|
| Supernova               | 400                          |                          | Advance by another metal in another unit |
| Platinum                | 350                          |                          | Advance by one metal in another unit     |
| <b>Gold</b>             | <b>300</b>                   |                          | "A" work                                 |
| Silver                  | 250                          |                          | "B" work                                 |
| Bronze                  | 200                          |                          | "C" work                                 |
| Copper                  | 150                          |                          | "D" work                                 |
| Aluminum                | 100                          |                          | Developing                               |

### Lesson 1 ( / / )

- FYI page
- 15.1 Characteristics of Life
- 15.A Macromolecules Needed for Life
- 15.2 Cell Types: Prokaryotic and Eukaryotic
- 15.B The Microscope
- 15.3 Tour of a Eukaryotic Cell
- 15.4 The Cell Membrane
- 15.5 Transport In and Out of Cells
- 15.6 Cell Communication

- 15.7 How Cells Reproduce
- 15.8 How Cells Use Energy
- 15.C ATP and Chemical Reactions in Cells
- 15.9 Photosynthesis
- 15.10 Cellular Respiration and Fermentation
- Lesson Reading Quiz
- Homework Practice Session

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### **Lesson 2 ( / / )**

- FYI page
- 16.1 What Is a Gene?
- 16.2 Chromosomes: Packages of Genetic Information
- 16.A The Structure of DNA
- 16.3 DNA Replication
- 16.4 How Proteins Are Built
- 16.5 Genetic Mutations
- 16.B How Radioactivity Causes Genetic Mutations
- 16.6 Meiosis and Genetic Diversity
- 16.7 Mendelian Genetics
- 16.8 More Wrinkles: Beyond Mendelian Genetics
- 16.9 The Human Genome
- 16.10 Cancer: Genes Gone Awry
- 16.C Environmental Causes of Cancer
- 16.11 Transgenic Organisms and Cloning
- 16.12 DNA Technology-What Could Possibly Go Wrong?
- Lesson Reading Quiz
- Homework Practice Session

PhET: Gene Expression

Video Share: CRISPR

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### **Lesson 3 ( / / )**

- FYI page
- 17.1 The Origin of Life
- 17.2 Early Life on Earth
- 17.3 Charles Darwin and The Origin of Species
- 17.4 How Natural Selection Works
- 17.5 Adaptation
- 17.6 Evolution and Genetics
- 17.7 How Species Form
- 17.8 Evidence of Evolution
- 17.9 The Evolution of Humans
- 17.A Did Life on Earth Originate on Mars?
- 17.B Staying Warm and Keeping Cool
- 17.C Fossils: Earth's Tangible Evidence of Evolution
- Lesson Reading Quiz
- Homework Practice Session

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### **Lesson 4 ( / / )**

- FYI page
- 18.1 Classifying Life
- 18.2 The Three Domains of Life
- 18.3 Bacteria
- 18.4 Archaea
- 18.5 Protists
- 18.6 Plants
- 18.A Moving Water Up a Tree
- 18.7 Fungi
- 18.8 Animals
- 18.B Coral Bleaching and Ocean Acidification
- 18.C How Birds Fly
- 18.9 Viruses and Prions
- Lesson Reading Quiz
- Homework Practice Session

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## Lesson 5 ( / / )

- FYI page
- 19.1 Organization of the Human Body
- 19.2 Homeostasis
- 19.3 The Brain
- 19.4 The Nervous System
- 19.5 How Neurons Work
- 19.A How Fast Can Action Potentials Travel?
- 19.B Endorphins
- 19.6 The Senses
- 19.7 Hormones
- 19.8 Reproduction and Development
- 19.9 The Skeleton and Muscles
- Lesson Reading Quiz
- Homework Practice Session

PhET: Neuron (in Section 19.5)

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## Lesson 6 ( / / )

- FYI page
- 20.1 Integration of Body Systems
- 20.2 The Circulatory System
- 20.A Hemoglobin
- 20.3 Respiration
- 20.4 Digestion
- 20.5 Nutrition, Exercise, and Health
- 20.B Low-Carb Versus Low-Cal Diets
- 20.6 Excretion and Water Balance
- 20.7 Keeping the Body Safe: Defense Systems
- Lesson Reading Quiz
- Homework Practice Session

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## Lesson 7 ( / / )

- FYI page
- 21.1 Organisms and Their Environment
- 21.2 Population Ecology
- 21.3 Human Population Growth
- 21.4 Species Interactions
- 21.5 Kinds of Ecosystem
- 21.A Materials Cycling in Ecosystems
- 21.6 Energy Flow in Ecosystems
- 21.B Energy Leaks When Organisms Eat
- 21.7 Change in an Ecosystem
- Lesson Reading Quiz
- Homework Practice Session

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## Unit : D: Earth Science

### Unit D Grading

| <i>Metal<br/>Status</i> | <i>Points<br/>to Qualify</i> | <i>Points<br/>Earned</i> | <i>Grade</i>                             |
|-------------------------|------------------------------|--------------------------|--|
| Supernova               | 400                          |                          | Advance by another metal in another unit |
| Platinum                | 350                          |                          | Advance by one metal in another unit     |
| <b>Gold</b>             | <b>300</b>                   |                          | "A" work                                 |
| Silver                  | 250                          |                          | "B" work                                 |
| Bronze                  | 200                          |                          | "C" work                                 |
| Copper                  | 150                          |                          | "D" work                                 |
| Aluminum                | 100                          |                          | Developing                               |

## Lesson 1 ( / / )

- FYI page
- 22.1 Earth Science Is an Integrated Science
- 22.2 Earth's Compositional Layers
- 22.A Earth Developed Layers When It Was Young, Hot, and Molten
- 22.3 Earth's Structural Layers
- 22.4 Continental Drift-An Idea Before Its Time
- 22.5 Seafloor Spreading

- 22.C Magnetic Stripes Are Evidence of Seafloor Spreading
- 22.6 The Theory of Plate Tectonics
- 22.D What Forces Drive the Plates?
- 22.7 Plate Boundaries
- 22.E Life In the Trenches
- 22.B Using Seismology to Explore Earth's Interior
- Lesson Reading Quiz
- Homework Practice Session

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**Lesson 2 ( / / )**

- FYI page
- 23.1 What Is a Mineral?
- 23.2 Mineral Properties
- 23.3 Types of Minerals
- 23.A The Silicate Tetrahedron
- 23.4 How Do Minerals Form?
- 23.5 What Is Rock?
- 23.6 Igneous Rock
- 23.7 Sedimentary Rock
- 23.B Coal
- 23.8 Metamorphic Rock
- 23.9 The Rock Cycle
- 23.C Earth's History Is Written In Its Rocks
- Lesson Reading Quiz
- Homework Practice Session

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**Lesson 3 ( / / )**

- FYI page
- 24.1 A Survey of the Earth
- 24.2 Folds and Faults
- 24.3 Mountains
- 24.4 Plains and Plateaus
- 24.5 Earth's Waters
- 24.6 The Ocean



- 24.A The Composition of Ocean Water
- 24.7 Fresh Water
- 24.8 Glaciers
- 24.B Water Pollution
- Lesson Reading Quiz
- Homework Practice Session

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### **Lesson 4 ( / / )**

- FYI page
- 25.1 Processes That Sculpt the Earth: Weathering, Erosion, and Deposition
- 25.A Weathering
- 25.B Soil
- 25.2 The Impact of Running Water
- 25.3 Glaciers-Earth's Bulldozers
- 25.4 The Effects of Gravity Alone-Mass Movement
- 25.5 Groundwater Erodes Rock Making Caves and Caverns
- 25.6 Wave Effects
- 25.7 Wind-Agent of Change
- Lesson Reading Quiz
- Homework Practice Session

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### **Lesson 5 ( / / )**

- FYI page
- 26.1 The Atmosphere
- 26.A Atmospheric Pressure
- 26.2 The Structure of the Atmosphere
- 26.B Heating the Atmosphere: Solar Radiation
- 26.3 Temperature Depends on Latitude
- 26.4 Earth's Tilted Axis: The Seasons
- 26.5 Flow of the Atmosphere: Wind
- 26.C Wind Chill
- 26.6 Local and Global Wind Patterns
- 26.D The Coriolis Effect
- 26.7 Ocean Currents Distribute Heat

- 26.8 Water In the Atmosphere
- 26.9 Changing Weather-Air Masses, Fronts, and Cyclones
- Lesson Reading Quiz
- Homework Practice Session

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**Lesson 6 ( / / )**

- FYI page
- 27.1 Earthquakes
- 27.2 Tsunami
- 27.3 Volcanoes
- 27.4 Hurricanes
- 27.A Climate Change
- Lesson Reading Quiz
- Homework Practice Session

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**Unit : E: Astronomy**

**Unit E Grading**

| <i>Metal<br/>Status</i> | <i>Points<br/>to Qualify</i> | <i>Points<br/>Earned</i> | <i>Grade</i>                             |
|-------------------------|------------------------------|--------------------------|--|
| Supernova               | 400                          |                          | Advance by another metal in another unit |
| Platinum                | 350                          |                          | Advance by one metal in another unit     |
| <b>Gold</b>             | <b>300</b>                   |                          | "A" work                                 |
| Silver                  | 250                          |                          | "B" work                                 |
| Bronze                  | 200                          |                          | "C" work                                 |
| Copper                  | 150                          |                          | "D" work                                 |
| Aluminum                | 100                          |                          | Developing                               |

**Lesson 1 ( / / )**

- FYI page
- 28.1 The Solar System and Its Formation
- 28.2 The Sun
- 28.3 The Inner Planets
- 28.4 The Outer Planets

- 28.A What Makes a Planet Suitable For Life?
- 28.5 Earth's Moon
- 28.6 Failed Planet Formation
- Lesson Reading Quiz
- Homework Practice Session

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SolarSystemNTQ.pdf

### **Lesson 2 ( / / )**

- FYI page
- 29.1 Observing the Night Sky
- 29.2 The Brightness and Color of Stars
- 29.3 The Hertzsprung-Russell Diagram
- 29.4 The Life Cycles of Stars
- 29.5 Black Holes
- 29.6 Galaxies
- 29.A The Search for Extraterrestrial Life
- 29.7 Looking Back In Time
- 29.8 Dark Matter and Dark Energy
- Lesson Reading Quiz
- Homework Practice Session

Video Share: Black Hole

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