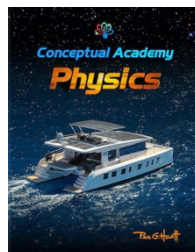


Teacher's Manual

Conceptual Academy Physics

High School — Directed Self-Study Program



Thank you for signing up for *Conceptual Academy 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 program 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 coach—cheering them onward and providing personalized help as needed—and their personal guide through the day-to-day. The purpose of this manual is to provide you, the teacher, a bird's-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.

1. About Conceptual Academy Physics

Having been approved by multiple state boards of education, *Conceptual Academy Physics* fits the traditional one-year high school physics requirement. The program is organized into units, where each unit corresponds to a chapter of the accompanying textbook. There are 16 units in total: an opening unit covering the textbook's Introduction (About Science), followed by 15 chapter units. The PDF pages of this textbook are embedded within the online program. The printed textbook is optional but recommended and can be purchased through our print-on-demand service here:



Conceptual Academy Physics Printed Textbook
IngramSpark

Within each unit there are lessons, where each lesson corresponds to a chapter section. For a full year of study, the student should be paced at about 2 to 3 weeks for each unit (chapter). If your student is on the ambitious side, we recommend our Conceptual Physics Honors program, which has about the same depth but covers many more physics concepts, allowing for greater variety at a faster pace.

2. Laboratories

Science and experiments go together hand-in-glove. For this Conceptual Academy program 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 course’s first FYI page 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, also within the Doc Share of the course’s first FYI page. 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.

Also, there are about two dozen interactive simulations embedded throughout the program. 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—the mouth is open—where the student tries to articulate 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. Meet Alia

Embedded throughout this program is Alia, our AI learning assistant—and Alia is not your average chatbot. For privacy, accuracy, and focus, Alia is trained solely on Conceptual Academy’s content and pedagogy, including Socratic methods, and it always steers the student back to the course material. (The Alia in this program specializes in physics.) Your student can ask Alia to explain any end-of-chapter or Homework Practice Session question—not just the answer, but the reasoning behind it. Alia also fields questions about the platform itself.



Learn with Alia



Learning
Assistant

Here's a favorite feature: after a conversation about any science concept, your student can ask Alia for a practice quiz, which it generates on the fly from the context of that very conversation. One ground rule worth enforcing: the student should always try their best to answer a question **BEFORE** turning to Alia. Any good answer “makes sense” once heard. What counts is being able to create the answer oneself. Alia is there to confirm or correct that effort—never to replace it.

5. A Typical Student Day

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 unit.

Then there are the end-of-chapter (EOC) questions within the textbook. These are an important Step 2 activity for the student. Notably, the student can ask Alia for not just the answers but the explanations to any of these or other related physics questions. Alia will help the student to correct or confirm their understanding. It's also important that the student try their best to answer the question **BEFORE** getting the feedback from Alia. Any good answer will “make sense” after it's been provided. 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 hearing an answer and creating that answer themselves.

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 of learning resources. Variety is YUM! Let your student's days be filled with variety.

6. Grades—Summative and Formative

In traditional academics, most students are more focused on their letter grade than the actual learning that letter grade is supposed 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 couldn't 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 themselves 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 school year.

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 programs. This is the responsibility of the teacher who has been working directly with the student throughout the program of study. We are, however, very much in a position to provide formative grades throughout. These come in the form of the reading quizzes, the video quizzes, and the HPS, as tracked by the Conceptual Academy grade book. They also come in the form of the answers to the chapter questions

(through Alia), the answers to the Practice Pages available within the Doc Shares, and 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 unit. The HPS is an important Step 2 activity for the student after having studied the reading and video assignments for that unit. 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. Upon selecting an answer the student will be presented the correct answer. If they chose the correct answer they'll hear a clicker sound. Whether they get it correct or incorrect, it's a good idea to follow up with Alia for a thorough explanation.

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, there's opportunity to take it to the next level. We suggest you require your student to earn at least half of all the points available. At the time of this writing, there are 3,766 points available across the program, so we recommend you push your student to earn 1,883 points by the end of this program—ideally with that effort distributed across all the units.

Point Goals for the Automated Quizzes and HPS (Full Program)

Metal Status	Points to Qualify	Grade
Supernova	2260	Shaking the Universe
Platinum	2071	Above and Beyond
Gold	1883	"A" work
Silver	1695	"B" work
Bronze	1506	"C" work
Copper	1318	"D" work
Aluminum	1130	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 level beyond gold (platinum and supernova) can be banked to compensate for a lower grade earned on the field journal or unit exams.

How to pace your student toward 1,883 points? Look to the grade book. You'll see that the student's point tally for a unit turns blue after they've reached the halfway mark for that unit. They can continue to earn points within that unit, which will still count toward the point total. This can make up for other units where perhaps they don't reach the point threshold. But, ideally, the student should be distributing their effort across all the chapters, which means blue-colored tallies across all the chapters.

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 (field journal), unit exams, and any special projects.

How to Answer Questions

There are many question types throughout this program: video check, reading check, homework practice sessions, textbook end-of-chapter questions, lab activity questions, and the unit exams.

Think of each question as a conversation starter. Ideally, the student has someone they can explain their thoughts to verbally... or by text if using Alia. There's a discussion that leads to an agreement. Only then is the actual answer or explanation provided. 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 on to 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 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 questions is great preparation for the unit exam and even life beyond the unit exam. 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!

There are six unit exams across the academic year, each covering a group of chapters: Unit Exam A (Introduction through Chapter 3), B (Chapters 4–6), C (Chapters 7–8), D (Chapters 9–10), E (Chapters 11–13), and F (Chapters 14–15). You’ll find the PDF for each unit exam in the Doc Share on the FYI page of the last chapter it covers—that is, on the FYI pages of Chapters 3, 6, 8, 10, 13, and 15. 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 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 for 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 grades 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 exams.

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. The remaining 50% might then rest on the quality of the student’s writing and 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 authors and awaiting the signature of the student’s mentor.

7. Putting It All Together

In addition to the textbook, you’ll find our library of video lessons (integrated with the textbook), the automated quizzes, the HPS, the Practice Pages, the unit exams, study advice from the authors on each FYI page, interactive simulations, plus a number of Easter egg surprises sprinkled here and there. And for technical support, please write to 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, in this modern age it is critically important for any student to understand science for what it is, for what it can and cannot do, and for how—for better or worse—it has shaped our daily lives.

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

Good science to you!

The Conceptual Academy Team

