NOVARE
SCIENCE & MATH
MASTERY. INTEGRATION. KINGDOM.

Implementation Tips for Novare Textbooks

Maximize Your Students Success With These Strategies

John D. Mays

Testing agencies, pollsters, and documentarians continue to produce evidence that the scientific literacy of high school students in America is seriously deficient. No doubt there are many causal factors. One is the continued use of teaching practices that foster what I call the *Cram-Pass-Forget cycle*—students cram for tests, pass them, and then forget most of what they crammed in about three weeks. I have long maintained that we need to replace the Cram-Pass-Forget cycle with a Learn-Master-Retain cycle. Doing so requires changes in the ways teachers teach and in the ways students study.

Many of my readers are well aware of the fact that textbooks produced by Novare Science & Math are specifically designed to help teachers and students break the Cram-Pass-Forget cycle. Users of our texts should thus expect that teacher and student practices must be adapted to the way the texts are designed—using them the way conventional texts are typically used does not make full use of the unique features in the design of the texts.

Recommendations for how to teach with our texts are scattered around in various books an articles. I thought it would be helpful if I summarized some of these practices here together. Accordingly, here are my top tips, for students and teachers, in no particular order.

1. Students: *Follow the example problem solving method closely*. (This applies to all physical science and physics courses.)

   Each of our physical science and physics texts includes a detailed problem-solving method. Unless directed otherwise, it is quite common for students to ignore this method, more or less, assuming the details are unimportant. However, students typically have not developed careful problem-solving skills, and often take shortcuts such as not showing all their work, not showing units of measure, and performing calculations without first preparing the correct units and equations. It is usually obvious when a student is not following the method—they lose lots of points on the computations on quizzes, and these losses mount as the number of different types of problems increases during the year.

   To ensure that students perform well on quizzes, it is critical that instructors examine students' problem solutions and make sure they follow all the steps in the problem-solving method *exactly*. When students follow the method carefully, they almost always earn high scores.

2. Students: *Take the recommended study strategy seriously*.

   A major component of our mastery strategy is that the content on the quizzes and tests we provide on our Resource CDs is cumulative from the beginning of the course. Since most courses are not structured this way, students are almost never trained in correct study practices when they begin taking a course using one of our texts. Students studying in a conventional way will not be prepared to address questions reaching back several months.

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FAQ: What Is the Thinking Behind the Structure of *Novare Physical Science*?

John D. Mays

People sometimes ask about the unconventional structure in our popular text, *Novare Physical Science*. For example, one customer wrote, "There are several experiments in Chapters 1–8 that involve taking measurements. Why do you wait until half way through the year to discuss the subject?"

The answer to this question involves a number of different threads.

First, the target age group for the book is 6–8 grade. Considering the younger ones in that age range, I did not want to bring in the math too quickly. Better to let them get their feet wet with the first half of the book without any math, when they have had an extra semester of pre-algebra to prepare them. When we get to the mathematical applications of volume, density and so on, the math is now right before us, so this is the obvious time to dive deeply into the science and practice of measurement as a formal study.

Second, we don't want the study to be completely devoid of math during this first semester, so we sneak some math in in the experiments, where the math involved is familiar ground—making measurements.

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The only way to succeed in a mastery environment is to study for retention. Each of our texts includes a detailed study strategy in the Student Preface. Teachers should review this strategy with students at the beginning of the course and again after 4–6 weeks. If a student's grades begin slipping after 10–12 weeks, look at the student's quizzes and check performance on the review questions. Most of the time, a student who is losing a lot of points on review questions is not following the study strategy with respect to review activities.

3. Teachers: *Engage students with memory checks every day.*

Promoting retention is crucial in a mastery learning environment. During interactions with students in class, teachers should make it a daily habit to ask questions that require students to quote definitions or explain concepts from prior chapters. When a definition needs repeating, ask a particular student to state it for the class. When new material touches on a previously learned concept, call on someone to summarize it. The more teachers get students engaged instead of letting them sit passively in silence, the better (see item 7 for more on active engagement).

4. Students: *Complete all the tasks on the Weekly Review Guides.*

It is common for students to look over the Weekly Review Guide and believe they have done enough. However, reading over a list of review activities is not the same as performing the activities, and actually doing them is essential for exercising the memory and keeping old learning fresh.

The activities on the Weekly Review Guides require 2–3 hours each week to complete. This is why I typically give plenty of time in class for students to complete their assignments. By completing their assignments in class, their study time at home is opened up so they can work through the activities on the Weekly Review Guide.

5. Students: *Read the text.*

No text is perfect, but folks tell us that our texts are lucid and well organized, making for engaging reading. Reading the text is an important part of the learning process. However, many students have developed the poor habit of using the text only for the exercises, and sadly, it is also common these days for students not to read much at all.

One strategy many teachers use to motivate students to read is *flipping* the class. In a flipped class, students read the section under study and answer the questions before coming to class. Class time is then used for discussion, clarification, and enrichment instead of for presenting material students have never seen before.

6. Teachers: *Homework is for learning, not for grades.*

It is very common for students to do their homework mechanically, without really paying attention. This practice is evident if students are questioned about their assignment the following day and cannot answer the questions.

Your students should know that engaging thoughtfully with their homework is an essential part of success in your class. However, the common practice of awarding credit in students' grades for their homework is not helpful. As I always say, homework is a necessary learning activity, but it is not a legitimate assessment of whether learning has occurred. I maintain that grades should reflect learning, and homework doesn't do this. Thus, I advocate the following homework policy: Require students to complete their assignments. Collect the assignments and record whether students have turned in complete papers. Contact the parents of students whose papers are missing or incomplete and inform them that the student's work was inadequate.

After you have eliminated grades for homework (except, perhaps, for a token 5% for middle school students), take the next step toward making homework really effective by engag-

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ing students in deep discussions about their responses to homework questions, as described below.

7. **T**eachers: *Encourage students to own their own learning process.*

   In today's school culture, it is virtually ubiquitous for students to be in a passive mode in class and to look at assessments as boxes they must check off on their way to completing the class and moving on to the next one. Almost nothing is more subversive to the learning process than this.

   There are many things you can do as a teacher to encourage students to be active participants in the learning process. For starters, make your classroom a dynamic and interesting place by varying your classroom activities regularly to keep up interest.

   When it is time to discuss responses to questions in assignments, avoid simply telling students the right answer. Instead, involve students in the discussions by asking students to relate their own responses to questions, then have other students comment on them. Students will be much more interested and engaged when discussing their own work or the work of their peers.

   Do not score or correct student papers. Instead, make students responsible for their own learning and preparedness by discussing questions in class (as described above) and letting students judge for themselves whether their own responses are adequate.

8. **S**tudents: *Follow up on missed quiz questions.*

   In most classes, students safely assume that they will never see test questions again until the final exam. But in our mastery environment, they are likely to see questions again on future quizzes or tests.

   Since students are likely to see questions repeatedly, it is important that they follow up on each question for which they lose points to find out why they lost points and how to address the question more adequately next time. Students should also make it a practice to review old quizzes or tests regularly as part of their review work.

9. **S**tudents: *Master definitions of key terms.*

   An important part of students' study is to write key terms on flash cards and drill them. Drilling the flash cards is also part of the review regimen to keep definitions fresh for the duration of the course. (By then, students have spent so much time reviewing the definitions that they usually remember them for years, which is, of course, the goal of mastery learning.)

   In all our courses, vocabulary terms appear over and over again on quizzes and tests. To be successful, it is essential that students master the definitions of all the technical terms and keep the definitions fresh through regular review.

10. **S**tudents: *Be prepared for questions about scientists.*

    The quizzes we provide on our Resource CDs—particularly for the middle school physical science and freshmen introductory physics courses—regularly ask students to restate what they know about certain scientists and their contributions. It is not uncommon for students to neglect review of this material, and if they do they will be caught off guard when a question appears on a quiz. Students need to be reminded that questions about scientists keep popping up on quizzes or tests.

    In our introductory physics and chemistry texts, scientist lists are provided in the appendix to help students with their studies. Encourage students to make sure required information pertaining to scientists is on their flash cards, and to review the flash cards thoroughly and regularly.

11. **T**eachers: *Consider your school's math program.*

    It is not uncommon for the math program at a young school to receive less attention and investment than the humanities program. An underdeveloped math program can have an adverse impact on students' preparedness for courses such as middle school Physical Science. If the math program at your school is under-performing, physical science teachers should be prepared to slow down if necessary and use the opportunity to improve kid's math skills. When taught at the mastery level, these skills should have a positive impact on student's math performance. Teachers should also collaborate proactively with math teachers to help get math performance up to par.

The tips presented here are critical components of an overall implementation plan for using Novare textbooks. But, of course, these ideas are simply good teaching and study strategies that can be applied to any course using any text. We all know that if students study for retention they will be more successful than otherwise. It's just that students normally don't study this way and teachers sometimes neglect to encourage them to study properly.

When teachers and students both do their part, students experience how satisfying education can really be. They learn far more, master it, remember it, and think of the class thereafter as one of the highlights of their educational experience.

Can You Help With Our New Project?

If you are a science teacher, chances are you have often felt a sense of wonder when studying or contemplating the world God made. We want to help teachers communicate this sense of wonder to their students.

Toward that end, we plan to develop a new web resource for teachers—a library of jaw-dropping videos and video clips, sorted by course and topic, that teachers can use in the classroom.

If you would like to help us in this project, send us links to your favorite video clips. We will review them for inclusion in the links listed on our site. As an example, check out the 1-minute clip below of the eruption of Mount Tavurvur volcano on August 29th, 2014, captured by Phil McNamara.

https://www.youtube.com/watch?v=BUREX8aFbMs

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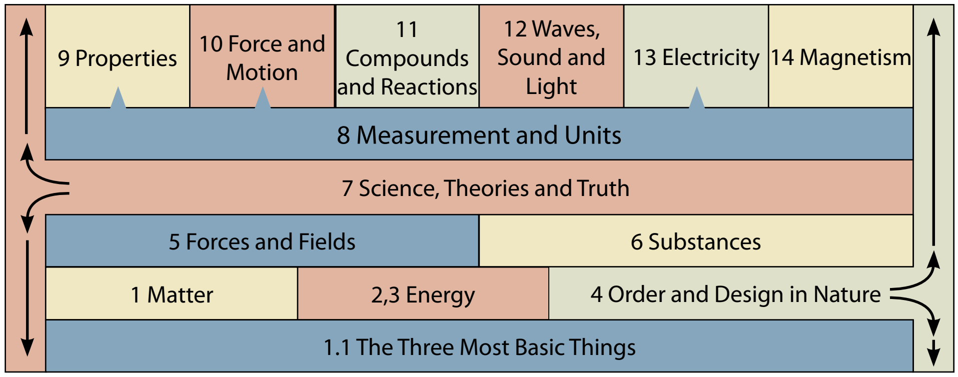
Third, as just mentioned, making measurements is actually familiar to everyone in this age range. They arrive in the class already knowing how to measure things with rulers and scales, and no formal training is necessary in order for them to get started with the experiments. In Chapter 8, we formalize that knowledge. Measurements are no longer the casual experiences familiar to students from a young age—weighing themselves, measuring how tall they are, and so on. They are now part of the formal discipline of physical science. And in that light, measurement is now treated with some rigor, so we get into the history of measurement, the details of the SI System (some of which they already know), metric prefixes, and unit conversions.

Fourth, there is the notion here of approaching subjects from multiple angles successively in order to enrich the level at which students apprehend what we are telling them about. By having students make some simple measurements, record them in their lab journals, and even graph them, the students are engaging in the craft of using mathematics and measurement in science in a casual, practical way. There comes a time for the formal study, and that time is Chapter 8. But by then we have approached the subject twice, first casually in the experiments, and then more formally with the study in Chapter 8. And by the time we get to Chapter 8, the students have already encountered a few things that we need as part of this study—topics such as mass (Chapter 2) and temperature scales (Experiment 2).

Now that I have described the role of mathematics in the book, I will make some further comments about the general structure of the book. The entire text is structured in a layered fashion. Generally, topics are first covered conceptually; then we circle back and get into more detail. This is because the students' comprehension of abstract topics such as energy is improved if we start at the highest level—what energy is, where it is, and how we use it—and work down from there to the details. However, in the case of the math, I structured things the other way around so that the students' studies in mathematics have more time to catch up and give the students more solid ground to stand on. So in the case of the science of measurement, we start at the bottom—simple measurements everyone already knows how to make—and work our way up to the formal study.



At the most basic level, the design philosophy behind the sequencing of topics in *Novare Physical Science* is to treat first the most fundamental topics in a broad overview, and then to come back to these topics a second time to get into more of the details (including computations at an age-appropriate level).

In addition to this broadly double-looped structure, there are a several other key structural elements in the book's design. One of these pertains to the presentation of energy. Since explaining what energy is is essentially impossible (at any age level), I chose to present it through a discussion relating the major forms of energy to our major sources of energy in contemporary society. This places an important instance of technology application right in the middle of the broad overview of the "three most basic things" covered in the first four chapters, and makes the energy presentation very practical and interesting.

Another key structural element is the positioning of Chapters 4 and 7. These chapters are crucial for understanding our place in the world God made, and the nature of scientific knowledge. As such, we could call these "meta-chapters," by which I mean that their topics inform all our thinking about standard science content. The topic of Chapter 4 is the third of my trilogy of "basic things"—the intelligence in nature—which is why this topic has been placed in Chapter 4 (right after matter and energy). I placed the material on Science, Theories and Truth in Chapter 7 so as to come after the broad overview of Chapter 1–6 (which provides many examples of theories that can be discussed again in Chapter 7), but still early enough that subsequent chapters can refer to it. Placing this material in Chapter 7 also allows it to occur in the fall term, and thus the important and fundamental ideas from Chapter 7 can be regularly discussed for the rest of the course.

With the broad overview of fundamentals and meta-topics in hand from the fall term, the spring term opens with our entrance into the use of computations in science. Chapter 8 on Measurement and Units is another sort of meta-chapter, and once students are introduced to the use of math in science, computational applications arise over and over from then on. As mentioned above, a side benefit of waiting until the spring term to bring in the math is that students have had an entire semester of math by then, which should help them to be prepared for tackling the metric prefixes and unit conversions.

I have tried to illustrate these structural principles in the graphic above. At the bottom are topics that are most fundamental and general. Further up means getting into more and more detail. Chapters 4 and 7 are shown as spreading to influence and support all levels. Chapter 8 is shown pointing into later chapters with mathematical content.

Postscript

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