

Final Report

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Review of Middle School Physical Science Texts

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Purpose

The purpose of this grant was to review and critique the physical science in Middle School (grades 6, 7, and 8, although some schools called Junior High designate grades 7, 8, and 9) science textbooks with regard to the scientific accuracy, adherence to an accurate portrayal of the scientific approach, and the appropriateness and pedagogic effectiveness of the material presented for the particular grade level. We also noted such things as readability, attractiveness, quality of illustrations, and whether material such as laboratory activities, suggested home activities, exercises to test understanding, and resource suggestions were considered appropriate.

We want this report to be read so we have left in some of the humor, suggestions for improvement, references to available and often inexpensive tested materials, a variety of print styles, some references to aid teacher enhancement, some website addresses, and other reports of a similar nature. Early on we noted that listing all the errors would make this report much too long (over 500 pages) so we decided to set up a website dealing with errors in texts relevant to the Middle Schools.

This website will be maintained after the grant ends as a service to teachers, potential authors, and publishers. We also noticed that publishers, when presented with lists of errors, suggest that their new printing or edition has taken care of those errors. Subsequent looks at these “new” books showed some corrections and often more errors. Teachers, of course, do not have access to the many printings and newer additions as they are often dealing with books from the same publishers that are five to ten years old. We can expect the same to happen with the dissemination of this report. The website should help.

Procedure

A letter was written to all the relevant publishers as determined by lists garnered from school districts that were considering or had recently considered adopting science textbooks for Middle School grades. In some instances three letters were sent to publishers at different addresses. The letter explained the project, asked for a company liaison with whom we could communicate during the project, and asked for copies of their texts at the Middle School level. No publisher responded. Several letters came back “Undeliverable as addressed, forwarding order expired” and permutations on that theme. It appears that these addresses were temporary while decisions were being made and once a decision was made they left town. Telephone calls resulted in only two publishers willing to talk: Glencoe/McGraw-Hill and South-Western Educational Publishing. The former publisher sent a complete set of texts and the latter sent a sample (1 out of 14 slim volumes.) Neither volunteered a liaison.

The reviewers, for the most part, were quite familiar with local school districts and publishers and were able to locate not only the latest texts, but also texts seven and over ten years old that were still being used in school districts. Recognizing that some Middle School teachers may have used these same books in earlier editions we decided to include them in our survey. Each major market text was reviewed by at least two reviewers and no two reviewers reviewed the

same two books. A few other books used within smaller markets were also included to determine if there were distinguishing characteristics that might indicate a trend toward newer approaches that utilized findings from physics educational research. In addition a few books being used by teachers that were at a slightly higher level as resource material were looked at in a more casual way.

The reviewers all had physics and teaching backgrounds that varied from Middle School to graduate school. All had been involved in some way with the teachers and/or the curriculum at the Middle School level for many years. Many had presented papers at national and section meetings of the American Association of Physics Teachers (AAPT) and had served on various committees of that organization including The Committee on Pre-High School Physics. In addition, over 20 individuals, prompted by several talks by co-principal investigator (JLH), volunteered their experiences with texts, authors, and publishers. Although most were oral, some were written.

General Overall Observations

Sharon Walpole in “The Reading Teacher” 52 (4) 358-369 (1999) “Changing texts, changing thinking: Comprehension demands of new science textbooks” points out many things that textbook authors should consider when writing at this level. In particular, she writes, “Children do not naturally respond to illustrations, graphics, and highlighted items. They need instruction in how to make sense of these features.” Without such training much of the material presented is worthless, no matter how impressive the layout is to a mature reader. All our reviewers commented on the “busyness” of the texts and pointed out that a lot of the material had little to do with science.

The books have a very large number of errors, many irrelevant photographs, complicated illustrations, experiments that could not possibly work, and diagrams and drawings that represented impossible situations. It is no wonder that teachers and students alike find difficulty with physical science in the Middle Schools.

Some might suggest that corrections can come later, but evidence shows that many students are turned off by their Middle School experience and most never choose to take another physical science course. There is also clear evidence that it is very difficult to overcome early established information. “Hardwiring” is the common term used to describe how rigidly students (and adults) hold on to early conceptions.

The general reading level has deteriorated markedly over the last 20-40 years. The publishers, as noted later, have responded to this by dropping the level of science texts. William A. Henry, III, writes in In Defense of Elitism of Cornell professor Donald Hayes’ results of sampling 788 textbooks used between 1860 and 1992. Hayes says, “Honors high school texts are no more difficult than an eighth grade reader was before World War II.” On further reading, “...the language difficulty of textbooks has dropped by about twenty percent during the past couple of generations. ...Perhaps the best measure of what has gone wrong is the fact, attested to by textbook authors and editors, that publishers now employ more people to censor books for content that might offend any organized lobbying group than they do to check the correctness of facts. From a business point of view, that makes sense. A book is far more apt to be struck off a purchase order because it contains terminology or vignettes that irritate the hypersensitive than because it is erroneous.” Publishers are much more interested in satisfying a group of selection committee members who typically have little knowledge of the subject matter, but are impressed by pretty pictures and seemingly up-to-date new information which for the intended audience is not at all relevant. Our reviewers noted the same sort of “dumbing down” in these elementary texts and all the reviewers commented on their encyclopedic nature, not only encyclopedic, but also containing topics well beyond the capacity of Middle School students.

In our experience an “author” is one who wrote the book in question. There is a rich variety of college level textbooks and many high school level textbooks competing in the market place and most are highly accurate. This situation comes about as a result of the prompt response of colleagues to errors in new editions and printings and the close association of teachers with publishers’ representatives. This is not true of science texts used in grades K-8. The notion

of “author” in these texts is quite foreign to us. Of the several names listed in several of the textbooks none that we contacted would claim to be an “author” and some did not even know that their names had been so listed. Instead of authors we have a collection of people who “checked” parts or aspects of the textbook. Some of these reviewers actually panned the material and heard nothing further from the publisher.

Without a clear-cut author or pair of authors to “define” the text or give it direction, these texts fail miserably. Committees produce mush and it is very difficult to find anyone with the authority to make corrections. Instead of being able to deal directly with authors we dealt with “editors” and got answers to our concerns about inaccuracies such as “Well we have to make the science simple,” “We don’t think that your qualifications are good enough,” and “Our experts disagree with you.”

Reviews

Glencoe: Science Interactions – Course 1, 2, & 3, Teacher Wraparound Edition, 11 authors, Glencoe/ McGraw-Hill, 1998, ISBN0-02-828055-5

The stated objective of this program is to produce an integrated approach to the different sciences. The introduction contains a lot of description of pedagogical approaches. The promise is to “describe what is being taught, why it is being taught, and how it connects to themes.” The themes are: Energy, Systems and Interactions, Scale and Structure, and Stability and Change. Only the textual material was reviewed. The approach is to start with activities and demonstrations to get the student’s attention. The intent is to have students start by trying to decipher what is causing a discrepant event. This is laudable, but the result is disappointing. Most of the activities are familiar, but the question at the end of a chapter tends to be, “Where is the meat?” The integrated approach amounts to verbal descriptions without enough depth to understand what the disciplinary connection really is. The impression is that “integration” was used as a sales pitch more than showing real interconnections among disciplines.

General Conclusions:

This text contains a very large number of errors ranging from misleading statements and figures to incorrect science. A sampling of errors and suggestions are given below. They fall into three general categories:

- (1) The photos and other graphics are always very attractive, but they often do not illustrate the appropriate science. The work done by graphic artists needs to be checked by a scientifically knowledgeable person.
- (2) The authors appear to be very knowledgeable about chemistry and earth science, but they have made far too many errors in physics. The science content in general needs to be checked by outside experts.
- (3) There are a large number of inconsistencies between the text material and the wraparound notes for the teacher. It often appears that these notes were written for a preliminary version of the text rather than the final version

Students at this level are inclined to completely believe what they read. If the material is unclear or inconsistent, it can be exceedingly frustrating for the student as well as the teacher. If the science that is presented is wrong, it would probably be better if the student had never seen the material presented. The situation is almost as bad for the teacher who is perhaps not as expert in an area as they would like to be. All too often teachers at this level have had minimal training in physics, so it is doubly important that the physics, in particular, in a text be correct and clear. Textbook publishers and/or authors need to utilize the expertise of the large number of physics professors who are available and willing to help with the proper presentation of this science to our children.

Safety: page 40 - The activity calls for protective clothing and safety glasses and the student in the picture has neither. On page 196 the student pictured does not have the required “protective clothing” on. Page 482 – The text calls for “eye protection,” but the discussion does not. There does not seem to be any interaction among the graphic artists and the “authors” to ensure that the pictures, drawings, or diagrams illustrate what is intended. This is true for all the books specifically reviewed.

Figures: page 25 – The pictures do not clearly show the difference between the Appalachians and the Rockies. Page 31 – You can't see what is being done in Figure A. Page 35 – In Figure 1-6, the discussion of the figure and under Visual Learning the reader will be convinced that the distances between latitude lines will be equal. Page 42 – The lunar rock is not a rectangular solid and it has a mass of 443 grams. Page 57 – The speed of light was not first timed in 1926. The figure is meaningless. Something could be made of the scale, but the shadows have to go. The topic itself requires more physics than these students are able to handle. Page 64 – The student is supposed to be observing refraction and the pencil is not even in the water. Page 66 – The orientation of light and prism is wrong for seeing the spectrum. (Note: Most books handle this topic poorly even though it is easy to set up the experiment for children. A good opportunity missed!) Page 70 – It would be better to use a blue filter that cut out red light. Page 74 – There is no way that these colors can be right. Page 88 – In Figure 3-2, the string's motion is much too large. In Figure 3.3C, the sound wave representation is wrong in location, wavelength, and shape. Page 95 – Figures 3.7A and B show a larger amplitude rather than a longer length which will result in a wrong impression. Page 96 – The figure is useless – it doesn't show what it purports to show.

[In 100 pages we note almost 20 errors in figures. There are over 30 errors in figures in the rest of this volume alone. Surely there is a need for at least one of the eleven "authors" to spend some time with the graphic artists.]

Mathematics: On page 26 students are directed to find the volume given only the depth and width. On page 30 the scale (2cm =5ft) is too large. On page 40 the formula for the volume of a sphere that is given is wrong. On page 53 an inch from the flashlight is much too close. On page 59 the students are asked to find "How long ... " and they have not yet been given the tools to answer the question. On page 131 it is not obvious that the bags are the same size, but given that, the answer to the Visual Learning question should be "...because the cans have greater mass than the paper towels." On page 147 the expected answer to Using

Math a. is “a liter” but “liter” is not listed as an SI base unit nor is its conversion to base units mentioned. The graph in Figure 5-10 cannot be read to the accuracy quoted. On page 176 the reader is not told what a Venn diagram is so the Close Activity can’t be answered. On page 383 the answer to one of the questions is given as “southwest” whereas from the figure it is “south of west” but not 45 degrees. On page 385 the answer to question 3 is “7.8” not “8” times. In addition the student has not been told how to calculate speed yet. On page 386, the reader is told that the distance traveled by the roller coaster in a certain time is its average speed that is nonsense. In the figure on page 390 we are not told whether these are average or instantaneous speeds. On page 391 if you drove “to and from the amusement park” the distance would be greater than “32 kilometers” because the streets are not straight. On page 399 and elsewhere “m/s/s” is unacceptable and should be replaced by “m/s²” or “m/s²” everywhere. In addition the Sample Data on this page has too many significant figures. On page 401 the answer to Conclude and Apply is closer to “3.7” and the picture is not drawn to scale and the units along the axis are not cm as suggested by the discussion. On page 414 especially Figure 13.1 B it should be noted that Galileo found that neglecting resistance all objects fall with the same acceleration. If dropped from the same height then they would fall to the ground in the same time. The physics and associated mathematics at this point is getting very bad and there is no reason for it. Even average students at this point should be extremely frustrated.

Basic Information: Scattered throughout the text are pieces of information, references to other material, and suggestions. Some of the information is wrong, some references are to materials that don’t exist, and some suggestions are out of the range of the abilities of the audience. On page 22 there is no mention of the fact that what would most likely be seen crossing the U.S. in a plane would be the tops of clouds and on page 26 to suggest that passing over North Carolina they would see lots of tobacco farms is silly as one could not tell what or if crops were being grown. On page 41, students are asked, “How heavy is it?” and what is really wanted is the mass. In the Assessment students are told to use their graphs to answer question 1, but it is not clear what question 1 is. On page 53 there is no mention of the size of the shadow, which is the most obvious observation. On page 64 the reader is asked to “Imagine a toy truck ...” – this is difficult and not too

helpful anyway. On page 71 the text says yellow, magenta, and cyan are the primary pigment colors not red, yellow, and blue (as implied by Uncovering Preconceptions). Science at Home on page 81 assumes that the Moon is near the horizon in early evening and doesn't mention that this should be done with a full Moon. Troubleshooting on page 85 says "...pluck it with an upward motion." It works just as well with a downward motion; in fact, is easier to do and that is the way that it is pictured in the text. On page 94 Explore Materials calls for a "metal ruler" and the picture is of a plastic ruler. The Possible Hypotheses on page 98 are both wrong and the Expected Outcome on page 99 is wrong. On page 103 the table is not shown vibrating which is the point of the figure. On page 119 the ice cubes and lemon in the tea make the figure non-homogeneous. On page 122 the numbered answers do not correspond to the numbers on the questions. In addition, the iron particles were not separated by the magnet; they were separated from the sulfur. On page 125 everything in the refrigerator is a substance. Also "heterogeneous" and "homogeneous" have not yet been introduced. The answer to Question 4 on page 129 is "Yes." OWAANA, i.e. "one word answers are not acceptable". Page 137 mentions a "rainbow" which is a particular physical phenomenon and implies all the colors from red to violet. Here there are specific colors of light that are characteristic of the material. On page 139 under Preparation "always" should be "usually" and it should be mentioned that the plasma state is the most abundant state of matter, but not in the conditions typically found on Earth. Question 1 on page 149 can't be answered as there is no way that one can tell that the substance shown is sugar. As far as the reader can tell the drink on page 156 is unsweetened (as it should be for the topic at hand) and yet is told that it tastes as sweet at the top as at the bottom. Also, is the "clear solution" transparent or colorless? The picture is not colorless which is what one would expect. Page 169 has no "Step 7 above." Where are the labels for the diagram on page 170? Also, where is the Investigate that is referenced? Three questions are asked on page 185 and this Answer to Question might answer one of them. In the text a funnel is called for, but does not appear in the Materials list. On page 195 except for the picture the student would not know not to place the litmus paper in the solution. The answer to Understanding Ideas 3 on page 410 is wrong. The Content Background on page 426 expresses nonsense. On the same

page the acceleration due to gravitation is inexplicitly given as 7.8m/s^2 without explanation. The path of the volleyball on page 424 is non-physical. Isaac Newton was born in 1643 (not 1642 as indicated on page 425) and Galileo died in 1642. The skydivers pictured on page 439 are falling at constant velocity and the caption speaks of constant acceleration. The elephant and mouse with air resistance will have a dramatically different result because of the difference in surface area. Where are the questions that are answered on page 447? On page 440 the rocket is already in orbit at position 1 so it can't have been launched from there. What is the significance of the changing colors? Where is the Flex Your Brain activity mentioned on page 494? Assessment on page 495 has the slope longer and it should be smaller. The students are observing the effects of the waves and not the waves on page 543. On page 544 and 545 the transverse waves will move at right angles to the direction of the disturbance not the source. Critical Thinking 3's (page 571) answer should indicate that it is the train engine that has passed not necessarily the whole train. Connecting Ideas 3 & 4's answers on page 571 are nonsense. The equator is drawn incorrectly on page 603. On page 611 it is stated that the far side of the Moon is covered with craters, but doesn't mention that the near side is also. The answer to the Conclude and Apply 1 refers to the Full Moon, but the Full Moon is not included in the table. An important question to be answered is "Why are there two tides?" Tides were linked to the Moon long before Newton answered this question. Discussion under Assess on page 624 suggests reminding the students about some nonsense relating the value of "g" at the surface of the Moon having something to do with it weakly attracting the Earth.

The errors continue in the areas of electricity and magnetism. Charging a comb and explaining what happens with a nearby piece of paper (an insulator) or a piece of foil (a conductor) can lead to some excellent physics, but here it is missed. The Van de Graaff generator does not store charge in its base as it is grounded. The Earth contains the "other" charge. The water analogy is not clear. A battery is not a "charge pump." The circuits with bulbs are drawn incorrectly. Lamps do not supply voltage. It is very difficult to find batteries with mercury in them – the "danger" is not there. You cannot "map a magnetic force." ...

General Comments

If one were forced to choose a book to use in Middle School, it is a sorry state of affairs that among the most used books in the country this one would have to be it. Our reviews go downhill from here. There is a huge amount of clutter that detracts on every page from the learning of science. However it is not only this book, but all the books that fill up the pages with non-essential information (careers, supposed threats to the environment, multicultural efforts, a multiplicity of things to do that are not relevant to the question at hand, topics well beyond that appropriate to this age level, and a great deal of mixing of the basic sciences so that the student has no idea where one ends and another begins.)

Science Insights: Exploring Matter and Energy (Teacher Edition), M. DiSpezio, M. Linner-Luebe, M. Lisowski, G. Skoog, and B. Sparks, Addison-Wesley Publishing Co., Menlo Park, CA 1996

Summary

The most important conclusion of this review is that there are an incredible number of errors of scientific fact as well as things stated in such a way that they will produce confusion even if they are not technically wrong. Some errors are to be expected from our past experience with elementary school science texts. A survey of texts at a lower level several years ago suggested that the state of affairs with regard to elementary science texts might be improving. However, this is not the case here, this Addison-Wesley text is unacceptably full of errors, omissions, and confusions.

Here we present a few examples of the kinds of errors that are common throughout the text. First, there are statements that are just scientifically wrong. Absolute zero is defined as the temperature where molecules are so cold that they don't move (p. 210). Newton's first law is stated incorrectly (p. 60). The

statement is made that the force of gravity is 9.8 m/s^2 (p. 56). In many places it is said that an object is a force rather than exerts a force (for example, paint can example on p. 112). Several times it is stated that the buoyant force on an object is greater than the object's weight, although it is clear that they are referring to an object in equilibrium (p. 91-93).

In addition to these errors, there are many, many sections that are written in such a way as to be very confusing to students. For instance, heat is defined differently in different places and used in the reading material in ways that are inconsistent with the correct definition. Chapter 11 uses the word "electricity" with random meanings. In one sentence it means electric energy, in the next it may mean electric current, and elsewhere, electric charge. This problem arises because there is no real scientific definition of the word electricity. It is used merely as a generic term to describe the field of study of phenomena that involve electric charges. A careful writer avoids its use as much as possible. Also, in that chapter a water hose model is used to describe an open circuit. While it is just an analogy and therefore not technically wrong, it will leave the students with a mental picture of electrons spewing out into the air at the point where the circuit is broken. A frequent problem in the motion chapters is the incorrect implication of cause and effect. For example, consider the statement "acceleration is a change in velocity that results from speeding up, slowing down or changing direction," which occurs on page 43. Speeding up is a change in velocity – it doesn't cause a change in velocity. Later in the same page, we find the statement that "acceleration caused by motion in a circle is called centripetal acceleration."

The pedagogical material in the text is not much better than the reading material. The questions provided are often poorly worded, address material not covered, or require an answer that is parroted back from the text but certainly not understood. An example of the latter is the question in Chapter 2 that asks, "What is space-time?" Students can surely repeat the one sentence definition given in the text, but they will have learned nothing. On page 213, radiation is expected as an answer to an in-text question, but radiation is not introduced for another two pages. Likewise in the Check Your Understanding section on page 430, students are asked to explain how a rainbow is produced, but they have not been told that

different amounts of refraction occur for different wavelengths so they can't possibly explain this. The statement of a true/false question says, "A prism separates white light into colors." This is listed as true, and it is; however, the light could be any combination of colors not just white.

This text has far too few activities in it. There is one major activity and usually a couple of very short ones per chapter. In no case would we consider the major activity provided to be the best activity that could have been done for that set of material. Middle school students should be experiencing investigative science at least every other class period. In order to do this, teachers will have to bring in many outside activities not in the book. While there is nothing inherently wrong with this, few teachers have the time or inclination to do it nor do most have the background for accomplishing this. Thus, students are much more likely to have an appropriately hands-on science class if the activities are included in their textbook.

The pedagogical materials provided for the teachers are inadequate in a number of ways. Most importantly, many, many answers to the questions in the student text are incorrect. For instance, on page 41, the numerical answer to the Skill Builder question is wrong. There are some problems in the way the question is asked, but no possible interpretation of the question could make this the correct answer. In the chapter on light and color, students are given a picture of a spectrum produced by a prism and ask to list the colors they see. The answer provided for the teacher is a pat ROYGBIV, but one would be very hard pressed to see anything other than red, yellow, green, and blue. Many other examples are provided in the detailed materials, which follow. Secondly, there is no content information for teachers with weak science backgrounds. As long as we have teachers who were trained as generalists teaching middle school science, this will be a serious omission – particularly when the student text is so poorly written.

In general many more ideas on special projects and connections to other fields are provided than any teacher will ever be able do and most of them are not particularly exciting. It is as if they had to have something to fit in that box for

that chapter so they came up with something to fill the space. It would have been much better to have fewer and better ones. At the beginning of each chapter are suggestions for teaching strategies for gifted, at-risk and limited English proficiency students. The suggestions for the latter two almost always focus on definitions and condensing the main points of the chapter in a few sentences to be used as study aids. This may help these students pass the test, but it certainly won't help them learn science. The instruction for these students should be even more hands-on than the "regular" instruction. Each chapter also begins with a section entitled "Directed Inquiry". This turns out to be a series of questions the teacher is to ask the students about a photograph. This bears little relation to scientific inquiry. It is also apparent that the authors of these materials do not know what "operational definition" means in science. They have included it in their process skills list as it should be, but apparently they think it means giving everyday examples of a concept. Both these errors arise out of trying to include every possible educational buzzword in the book. "Inquiry" is hot so we have to have it. Likewise, if it is on the process skill list, we have to show that we are teaching it – even if we don't know what it means. Publishers should not feel that every possible educational innovation has to be in every chapter. They should indeed be up on the latest in pedagogical techniques, but they should pick a few and do them well, not try to do them all and as a result do them poorly. The one positive point here is that the concept maps are actually good.

We include a list of things found particularly well done, but the list is unfortunately short.

In summary, no student will increase his or her understanding of science by using this text. At best they will memorize some facts and at worst they will become convinced that they are not capable of understanding science.

As middle school usually includes sixth grade, we looked at the Addison-Wesley Destinations in Science sixth grade book (c1995). In contrast to the Science Insights book, it was quite good. There were some errors such as the ubiquitous drawing of molecules in solids, liquids and gases which makes it look like the density of the liquid is midway between that of the solid and gas, but the serious

errors were very few in number. There was little unclear text. A number of experiments are included in the text and for the most part they are good ones. The answers in the teacher's material were for the most part correct. There was some background science for the teachers, although not enough. The Teacher's Edition tells the teacher what major related points students should remember from earlier grades (assuming they used the Destinations in Science series, of course). The teaching tips are good and contain little educational jargon. A section in each chapter discusses why students need to study that particular topic. In short, the physical science sections of this book were much better and could be recommended to teachers.

Major Errors and Omissions

Page	
11	Table 1.2 gives SI unit of mass as gram rather than kilogram. It is, however, correct in the text on page 13.
40	Fig. 2.9 shows a speed versus time graph. The text refers to it as position versus time and asks the reader to compare it to a previous position versus time graph. The remainder of the paragraph discusses a position versus time graph for constant acceleration, which is apparently, what 2.9 was supposed to be. It is not simply a matter of the axis label being wrong because what is shown in 2.9 is a segmented graph not a smooth curve.
40	Does not mention average acceleration. They have speed versus time graphs for which they could easily have connected acceleration to the slope of the line in each section, but it isn't done. The Teacher Edition Math Connection does talk about slope but only suggests that it be applied to a constant speed graph.

41	The Skill Builder exercise is terrible. Students are asked to “apply the acceleration formula to calculate the acceleration at 4 seconds” from distance versus time data. The only information they have about acceleration is its definition as change in velocity divided by change in time. They are also asked to use the distance versus time information to make a graph showing acceleration. They are expected to find average velocity for each second and plot it, but this is quite a leap from the information in the text. The one numerical calculation shown in the teacher’s materials is incorrect.
43 and 50	“...an acceleration is a change in velocity that results from speeding up, slowing down, or changing direction.” Cause and effect are backwards here. It is a force that produces acceleration that is seen as a change in velocity. Also, acceleration is not change in velocity it is change in velocity per unit time. Continuing in the same paragraph, the statement is made that “acceleration caused by motion in a circle is called centripetal acceleration”. Again, motion in a circle is accelerated motion.
44	Life-science link talks about the force necessary to slow a person down from 50km/h in a car accident with no reference to a time interval. Omission of a time interval is contrary to what students have learned about acceleration. Also, it misses the opportunity to talk about how air bags work by increasing the amount of time over which the velocity changes. Then uses a rule of thumb that allows you to calculate the necessary force based on your weight. This will tend to foster the idea that force is related to weight rather than mass.
51	Fill in the blank question: The distance traveled in a certain amount of time is called _____. The TE says the correct answer is speed, but if I travel 10m in 2s my speed is not 10m. Even if the time were one second, the speed still would not be 10m. A distance cannot equal speed.
56	“Since the force of gravity is 9.8 m/s^2 , ...” and this after they have just said force is measured in newtons

60	The Skills Warmup asks students to consider an arm wrestling situation in which neither person can bring down the other's arm. Students are asked what they can infer about the forces. Most students will answer the two people are exerting equal forces on one another. This is in fact true by Newton's third law, but has nothing to do with the fact that the arms are not moving. It is no wonder that students have trouble with Newton's third law when examples like this lead them to believe that the forces are only equal because at present there is a stalemate. The answer given in the teacher's material says that because these two forces are equal and opposite there is no motion. This is wrong. The force person A exerts on person B does not affect person A's motion. The book has completely ignored the forces between the person and the table that are very important here.
60	Newton's first law is stated incorrectly: "...an object in motion will remain in motion unless acted upon by an outside force." It should say, "will remain in motion at constant velocity." This is a very serious error, as students will commit this to memory for life.
61	"Friction works in the opposite direction to the force of motion." There is no such thing as a force of motion.
64	Activity in Skills Warmup does not control variables and ignores it. Says a long pencil will roll down a ramp more slowly than a short one because greater surface area gives more friction, but it ignores the difference in mass between the pencils. This is particular egregious when they are about to introduce Newton's second law.
76	Text states that the acceleration of gravity on the Moon is 1/6 that on the Earth because the mass of the Moon is 1/6 the Earth's mass. First, the mass of the Moon is about 1/80 of the Earth's not 1/6. Second, they have totally ignored the fact that the acceleration due to gravitation is also related to the radius of the body.
79 and 81	Page 73 correctly lists the four fundamental forces. In the chapter review and in the answer to Check and Explain question 1, they are listed incorrectly.

81	Check your vocabulary - fill in the blank question: “When your body is at rest, you have _____.” Expected answer is inertia, which is indeed a true statement, but it implies that you don’t have inertia if you are moving.
91- 93	Several times it is stated that the buoyant force on a floating object is greater than its weight. Pictures shown with this label show an object in equilibrium. This might be OK as an introductory statement if they clarified what was meant later, but they don’t. They never talk about how much of an object is above the water when floating in terms of the buoyant force. They do mention it at the very end of the section in terms of density difference, but this is inadequate – particularly given the incorrect statements about the relation between buoyant force and weight.
91 and 103	“The force gravity exerts on an object is equal to the object’s weight.” Sounds like these are two different forces that happen to be equal in this case. Sentence should say, “The property of an object that we call weight is the magnitude of the gravitational force that the Earth exerts on the object.” Or better yet, be omitted, as students should already know this.
98	The discussion of Bernoulli’s principle states that the air moves faster over the top of wing in order to arrive at the back end at the same time as the air that went under the wing. This is nonsense.
107	Text implies that the force you exert on the floor does work which moves you forward. More nonsense.
112	A frequent error in the entire book is to say an object <u>is</u> a force rather than <u>exerts</u> a force. An example is in the discussion of opening a paint can lid with a screwdriver in the section on levers. The statement is made that the lid is the resistance force.
123	Gets the definition of heat correct unlike later in the book (see note re page 209 below). However, the term heat energy is then used on the next page to mean thermal energy.

130	<p>The science literature connection is a story about a boy that can travel in the 4th dimension. While there is much science that can be learned from science fiction, this particular story is totally inappropriate. There is no science accessible to middle school students to be learned here. The text claims that it explores frames of reference but it does not. In the critical thinking section students are asked how frames of reference might differ in 2-D, 3-D, and 4-D space. The answer given is nonsense. As far as we are concerned, having this story in a science book just gives credence to the new age nonsense such as energy auras that students are bombarded with outside of school.</p>
140	<p>Typical incorrect picture illustrating the difference in solids, liquids, and gases. Shows density of liquid as much closer to the gas than the solid. On page 146, students are asked to draw diagrams showing the spacing of particles in a solid, liquid, and gas. Their drawings will certainly be incorrect since the ones in the text are.</p>
145	<p>“At very high temperatures, over 1,000,000 ° C, gas particles break down, forming a plasma phase.” There is no mention of charged ions or dissociated electrons. This sentence could just as well mean that the nucleus comes apart into its constituent protons and neutrons. While the original definition of plasma was a gas in which all atoms were ionized, the term has come to be used for any gas in which a sufficient number of atoms are ionized for electricity to be easily conducted through the gas. In this use of the word, the gas inside a fluorescent light is a plasma, which makes problematic the text’s statement that no solid substance can contain a plasma. The Teacher’s material does in fact talk about fluorescent and neon lights as plasmas. There is no reason to bring up plasmas here. Most college thermodynamics books don’t even discuss plasmas. If plasmas arise later in the context of stars or attempts to create fusion in the laboratory, then a simple statement can be made that a gas in which many atoms are ionized behaves so differently from neutral gases that they are given a special name.</p>

160	<p>“Strong force actually gets larger as the distance between the particles increases.” While this statement is true over a very limited distance range, no mention is made of the limitation. The statement makes no contribution to the paragraph and should have been omitted.</p>
209 and 227	<p>Paragraph defining heat energy is less than perfect. a) gives the impression that heat and heat energy are different. b) states “Energy that is transferred from one substance to another is called heat energy.” While the next sentence does go on to say that heat flows between objects that have different temperatures, students will take the first sentence as a stand-alone definition of heat energy. In fact, in the chapter review this definition is repeated with no reference to a temperature difference. This would make the energy transferred when a person compresses a spring, heat energy.</p>
210 and 227	<p>Absolute zero is defined as the temperature where molecules are so cold they don’t move. This is incorrect. At 0 K atoms have their lowest possible kinetic energy but it is not zero. Also, the fact that this temperature is not attainable in the laboratory should be mentioned and isn’t. This error is repeated in the end-of-chapter Check Your Vocabulary section.</p>
215	<p>Defines radiation incorrectly as infrared only. Later states that all rays from the Sun are radiant energy that would imply the Sun only emits infrared.</p>
227 and 228	<p>In Concept Summary and answers to Check Your Knowledge questions, that you know “energy” has been transferred if there is a change in temperature of a substance. The phrase “or a phase change has occurred” should be included.</p>

260 and 266	In an activity on the force between charged objects, students are asked to observe the attraction between a charged balloon and an uncharged cotton ball. There is no information whatsoever in the text that would allow them to be able to correctly explain their observations. This is a major omission. Even if this were not a specific part of this activity, students would certainly notice the balloons being attracted to other objects such as their hands. Thus, providing this explanation is extremely important. Later on students are asked to bend a stream of water with a charged comb. Why do it when you aren't going to explain what causes it?
267, 270 and 283	"The difference in the charges at each end of the wire is called potential difference, or voltage." This is a nonsensical statement. Later, voltage is defined as "the amount of energy available to move charges." This is also incorrect. If one were talking about a battery, then the statement that voltage is <u>proportional to</u> the amount of energy available to move charges would be acceptable. However, as a general statement this is also unacceptable.
Ch.11	Uses the word electricity with random meanings. In one sentence it means energy, in the next it may mean electric current, and elsewhere, electric charge.
270	Uses the term "flow rate of electric current". Electric current is itself a rate. It does not have a flow rate.
283	"Resistance is the force opposing the flow of electrons." Electrical resistance is not a force.
290	Refers to the magnetic pole located in the Arctic as the Earth's magnetic north pole when it is really the magnetic south pole.

294	Fig. 12.9 correctly shows the direction of a magnetic field produced by a current in a wire. However, the current is shown leaving the positive terminal of the battery. In the earlier chapter on electricity only electron current was discussed not conventional current, so the current was always shown leaving the negative end of the battery. We might be willing to let this go saying that not many students will notice the difference. However, in Fig. 12.10 the current is again shown leaving the positive end of the battery but this time it is actually labeled as flow of electrons!
302	The statement is made that a generator changes magnetic energy into electric energy. If this were true, the permanent magnets would continually get weaker. In the chapter review, it is correctly stated that generators turn mechanical energy into electric energy.
336	The term "heat wave" is used. Judging from terminology elsewhere in the book, they mean infrared radiation. However, heat wave is not a term used by scientists; it does not make any sense in terms of the definition they have given for heat; and the only meaning the term has for students is several days of unusually warm weather.
343	"Even though compressions are not the same as crests, they correspond to one another. Compressions and crests both indicate the amount of energy in a wave. Rarefactions and troughs also correspond to each other. They indicate the lowest energy." The three sentences are fine. The last is nonsense.
441	Statement is made that only high-frequency light, such as violet light, will supply enough energy to release electrons from metals and that red light does not have enough energy. This is clearly untrue. Green light can release electrons from sodium and even red light can release electrons from potassium. No mention is made of the fact that how much energy is needed depends on the type of metal

565	In talking about radioactive elements, the statement is made that scientists can create elements that never existed before. How would we know that they have never existed? They may well have existed, but since decayed into some other element. At best one can say that they no longer seem to exist in nature on Earth.
568	Talks about half-life, but there is no discussion of the randomness of the process. Students will be left asking, ‘How do the atoms know when it is their turn to decay?’
571	Have a picture showing the reaction $n + U^{235} \rightarrow Ba^{141} + Kr^{91} + 2n$ which doesn't balance.
573	‘Great amounts of heat are given off during fusion.’ Again, we have an incorrect use of the word heat. Both in terms of its correct definition and the book's use of it to also mean infrared radiation. The energy produced in the fusion process is gamma radiation not infrared.
573	‘Unlike fission, fusion doesn't happen spontaneously.’ Then how are the fusion reactions in the Sun happening? The sentence could be corrected by adding, ‘at temperatures usually found on Earth.’

At this point we feel that it would not be worthwhile adding eight pages of ‘Lesser Errors and Confusing Statements.’ Obviously, **NOT RECOMMENDED**.

 Science Links, South-Western Educational Publishing (*Everyday Learning Corporation*) 1998

Science Links is a one-year multimedia curriculum of integrated science designed for ninth-grade (or bright eighth-grade) students. In addition to a student textbook for each module, there is a Teacher Edition that contains suggestions for conducting and scoring tests and lab exercises, supplementary readings, class activities, suggested classroom procedures, and a series of videodisks and

videotapes. The text material is contained in a 14 volume set of booklets of 88 pages each covering all the sciences that can be used in any order. The format is both convenient and interesting.

Volume 2: WILDFIRE! A Study of Heat and Oxidation is an interesting module. There are indeed a number of physical, chemical, biological, and ecological ramifications of a fire. During my lifetime (HPL) the understanding of these things has changed. When I first went to Montana as a kid there were forest fires being fought assiduously and nowadays some forest fires are intentionally allowed to burn. It turns out that on occasion frequent brush burning fires are good for the forest. The policy in the national parks has changed to encompass this idea. The unifying feature of the wildfire is a good idea. Wildfire was quite good, and the number of errors was nowhere near the number in other books at this level.

However, Volume 3: MOTION COMMOTION A Study of Forces and Movement is not as neatly tied together and it breaks down frequently. On pages 70 and 71 students do a number of experiments to see what deformations happen to various objects in a can crusher with varying pressures caused by hanging a bucket on the can crusher's handle. Weights (bricks with a maximum mass of 25 kg) are added to the bucket. The can crusher pictured has been drawn by someone who has not seen one. A can crusher is a neat tool, and the compound levers enable even the weakest of us to crush cans without injury. It's instructive for students to see its levers in action. Hanging weights on its handle will require computations to determine weight on the sample and including friction in a real machine will prove a serious problem.

On page T3.67a ("T" refers to pages in the Teacher's Manual) the teacher is told about the samples to use in the can crusher experiment. These thicknesses can't possibly be right. Any conclusion, interpolation, or supposed understanding from these numbers will not hold water. As a simple experiment one could call Coca-Cola at 1-800-438-2653 and ask for the appropriate data. Then make a table of the thicknesses for different drinks. Then do the same for Campbell's Pork and Beans. Call Campbell's at 1-800-232-6736. Best of all, get the students to make

their own measurements.

Illustrations and teacher wraparounds appear to be add-ons after the student text was done.

Page T3-2 uses “fluid”, but a fluid could be a gas or a liquid and since fluids are not very compressible their use in a vehicle suspension system would not be effective. Also “If everything is in motion” then it is impossible to have a fixed point anywhere.

Page T3-101 includes this incorrect sentence, "Skin is not a good conductor because the moisture in it allows the current to pass through more easily."

Science Links is economical in the variety of its illustrations. A Hydroponics Grower on page 9, in Volume 1 has an orange hard hat and a yellow and black checked shirt. The same illustration is used for an archeologist, a wildlife manager, a food scientist, an oil refinery worker, a forest manager, a soil-conservation agent, a mineral prospector, a wildlife biologist, a plant breeder, a cattle breeder, a coastal resource manager, a horticulturist, an economic entomologist, a park ranger, a veterinary technician, an aquaculturist, a gem cutter, a goldsmith, a hydrologist, a range conservationist, an aquaculture technician, a farm operator, an agronomist, a marine biologist, and commercial fishers (sic). These are all the same guy! Have you ever seen a goldsmith wearing a hard hat? There are lots of other Career Links that have multiple repeated pictures calling attention to totally inappropriate careers. The publisher apparently saves quite a bit of money by repeating pictures. South-Western Educational Publishing was a division of Thomson Learning, at 1 800-824-5179. www.swep.com was the Internet address. They may now be Everyday Learning Corporation located at <http://www.everydaylearning.com/sciencelinks/> The Agency for Instructional Technology is at 1 800 457-4509

The Periodic Table of the elements lists 94 elements on page 1.25. Technetium and francium are identified as man-made. This is simpler than the way the table

is presented in other texts and more appropriate for this level.

Page 3.27 explains the operation of a speedometer: "Force is applied to the short arm by one of the car's wheels. This long arm extends from the wheel to the tip of the needle on the speedometer gauge. The faster the wheel spins, the more the tip of the needle moves. The large wheel and tire may spin many times per second, but the needle moves only a tiny distance across the face of the speedometer. The input force is much greater than the output force."

Page 3.42 shows an unlikely screw jack.

Page 3.70 shows an unlikely can crusher. The teacher's edition has students crushing aluminum cans with very large wall thicknesses.

Page T 3.94 tells about the screwdriver with a 3 cm tip and a 24 cm handle, used as an example of a lever to open a paint can.

Page T 3 47 has the Coriolis effect and the airplane traveling from Atlanta to Los Angeles to Chicago. The most westerly route is most efficient as the Earth turns toward the east. The clockwise route is most efficient because of the Coriolis effect. Students are to modify the plane to burn hydrogen fuel to make it more efficient (How will they carry the tanks?) and they are to modify the propellers to a steeper pitch (Notwithstanding that the usual pitch of the propeller is computed to permit most efficient use of the engine's power curve).

Page T-3.12 "Preparing Materials": "Screw in two hooks, one in the middle of the side with the smallest surface area and the other in the middle of the side with the largest surface area." The illustration on the same page (Figure 3) shows a hook in the middle of a side with the smallest surface area but the other hook is shown centered near the edge of the block rather than in the middle of the surface.

Page T-3.12 "Preparing Materials": "The percentage of stretch (of a rubber band) will indicate the measurement of force." Unlike a spring scale, the stretching of a rubber band is not linear with respect to an applied force. Any quantitative data

obtained using stretched rubber bands will be meaningless unless the individual rubber bands are calibrated, in advance, using a spring scale. It is strongly recommended that an experiment dealing with stretching rubber bands be carried out in reverse to ensure that the band comes back to the same length with which it started.

Page T-3.15: (Note: this error is VERY BAD and will certainly lead to misconceptions.) Question 2 asks, "Explain why a block with a small surface area passing over a rough surface will have more friction than a block with a large surface passing over a smooth surface." The answer to Question 2 states, "The surface area of the block does not influence the friction, but the roughness of the surface does. Because the block with a small surface is passing over a rough surface, it will experience more friction." The question fails to indicate that the block with the small surface area and the one with the large surface area must be equal in weight so the normal forces that press the blocks against the respective surfaces are the same. The answer that is given implies that the contact area between two surfaces never affects friction forces. In fact the incorrect implication is reinforced at the top of page T-3.18 that states unequivocally, "Frictional force is caused by surface roughness and is proportional to the force pushing two surfaces together. Surface area does not affect friction."

Page T-3.18 (Near bottom of column 1): "Would a heavy person be more or less likely than a light one to slip on an icy sidewalk? Why do you think so?" Based on the lesson given in this module, students might give the incorrect response that a light person is less likely to slip on an icy sidewalk because of the weaker normal force that is acting between the person's shoes and the sidewalk. However, the heavier person's pressure on the ice would tend to melt the ice faster making it more slippery.

Page T-3.21 (Investigation 3): The student is instructed to use spring scales to measure forces applied to the ends of a meter stick that is supported by a fulcrum at the 20 cm mark. The weight of the meter stick itself is ignored in the investigation. The hardwood meter sticks that are specified for this investigation

weigh slightly more than a newton each. Thus, if the specified force of only 1 newton were applied to the end of the input arm of the meter stick it would partially balance the weight of the meter stick itself and produce approximately half the expected force at the end the output arm.

Page T-3.37 (On Your Own) Question 2: "If you fill a sink with water and then open the drain, the water will swirl as it goes down the drain. If you did this in Canada, in which direction would the water swirl, clockwise or counterclockwise? What if you were in Australia - which way would it swirl there? What is responsible for the direction of the swirls?" The answer given at the bottom of the page states: "In Canada, the water would swirl clockwise. In Australia the water would swirl counterclockwise. The Coriolis force is responsible for the direction in which the water swirls." The misconception that Coriolis is responsible for swirling water directions in sinks apparently still exists in the minds of some teachers (perhaps reinforced by "The X-Files?") It has been proven many times that it is the configuration of the sink or toilet bowl determines the swirling direction. The Coriolis effect (not a force) is only observed in large areas of the atmosphere and oceans of the Earth. It is never observed in sinks.

Overall assessment of Module 3: This module has been organized into four sections, each include one, two, or three major topics that are usually associated with courses in Biology, Chemistry, Physics, or Earth/space science. According to the Time Frame given on page T-3.vii of this module, all of the required readings, class discussions, lab activities, review of assigned homework, individual and group research, tests and assessments and other activities can be completed in 18 class periods of 45 minutes each. Based on my (HHG) eight years of experience teaching ninth grade science and thirty additional years teaching physics and earth science in high schools, I feel that it is extremely difficult for students to learn so much material and complete many of the activities suggested in so short a time.

Volume 4 CURRENT THOUGHTS: A Study of Electricity and Magnetism

Page T 4-91 has the teacher (who has been explaining binary code) ask students,

"Which of the following is another example of an "on-off" code?" The choices are among: a) Braille b) Morse code, and c) handwriting. And the answer is "b." However, Braille is very specifically a binary code. Instead of the 8 switch (= 8 "bits") byte of computer codes, the Braille code uses a 6 dot cell (similar to the sixes on dominoes or dice - two vertical rows of 3 dots each), and as Roger, a blind acquaintance who reads and teaches Braille points out, "The dots are there or they ain't!"

Prentice-Hall messes up the binary system too; saying 9 is coded as 00111001 and 17 is coded as 00010001 (pages 576 and 577 EXPLORING PHYSICAL SCIENCE). What is not stated is that the first example is from a commonly used computer language in which the first four characters identify the next four as a digit. Also not stated is that the second example is how 17 would be coded in binary notation if you were required to use 8 places. The zeroes to the left of the first one would be ignored. (In current base ten numbering 17 means seventeen. There's a one in the tens column and a 7 in the ones column. 017 means the same - there's a zero in the hundreds column, a one in the tens column and a 7 in the ones column.)

Student illustration caption tells why birds aren't zapped when they wander on to a high voltage wire. Page 4-29 says it's because, "The bird's claws would be in contact with only a small portion of the wire, and so there would be no difference in voltage on its legs. Therefore, current would not flow through the bird."

Nonsense.

Page 4.49 has students light up an incandescent light bulb by moving a magnet back and forth inside a coil of wire which has had its ends fastened to the bulb's fixture. It's important that students be able to carry out such an experiment. In order to do that we need more specifications on length, number of turns, etc. The previous experiment also needs more specific information.

Volume 6 IT'S IN THE FAMILY: A study of Heredity

Page 6.77 has a group of 8 sheep, which proves on closer examination to be a special effect by repeating sheep #1 3 times and then flopping these first four sheep to make the next four sheep. (An example of cloning?) The result is that 4 sheep are backlit by one Sun and the other 4 sheep are backlit by another Sun.

Because this is a science book students should be alerted to such image manipulation.

Volume 7 Making Waves: A study of Light and Sound

The canoe material on pages 7.20 and 7.21 is preposterous. I (HPL) would be happy to take any of my brothers and compete with the writer and any other person of the writer's choosing. The reason pairs of canoeists paddle on opposite sides and generally in synch is that the side of the canoe that gets the power will move ahead. If both paddlers paddle on the right, the right side of the canoe will move ahead, forcing the canoe to turn left. Each paddler's stroke start (while the paddle is tilted ahead and starts to move down) has a component that tends to lift the canoe on that side. If there is an analogous lift on the opposite side the canoe will retain its vertical integrity. In mid stroke while the paddle is nearly vertical, there is only horizontal motion. At the end of the stroke, as the paddle is pulled up, there may be some vertical component which pulls the canoe down into the water on the paddled side. Again, if that force is balanced by the other paddler on the opposite side of the canoe, it will retain its vertical integrity. Should it not retain its vertical integrity, it will tip.

Page 7.43 explains elephant communication "that human ears cannot detect" in vocal infrasound, defined as "very low in pitch - about 400 Hz". There are 47 notes on my (HPL) piano lower than 400 Hz, and there are 41 higher. 400 Hz is about one and a half semi-tones lower than the oboe's tuning A-440.

Page 7.60's right hand prism bends the red light the wrong direction as it enters the prism. As light of any color goes from air to a more dense medium, it is ALWAYS refracted toward the normal. The rest of the illustration could not be duplicated in an experiment. It would be so much simpler to make a drawing while observing light impinging on a prism!

Volume 11 Going for the Gold: A Study of Precious Metals and Gems

Page 11.35's prism illustration is difficult to duplicate or explain without

reflection along the bottom of the prism (bottom of the prism as illustrated). No such reflection is discussed. Therefore what has happened is that this illustration (which is described as presenting refraction) has bent the light in the wrong direction. Dispersion is not mentioned until later and then not sufficiently to describe what is taking place.

Page 11.36 has lost some of the text from the figure. Even so the diagram says nothing about the properties of the media or where the angles are measured from.

Volume 14 Liquid World: A Study of Oceans and Ocean Life

Page 14.11 draws the equator north of the Gulf of Mexico - approximately through Tallahassee. Presumably this is another incidence of the Coriolis effect. Did you know that the Coriolis effect causes the northeast trade winds that basically sweep toward the southwest from the Horse Latitudes of southern Canada?

There are 24 “authors” of SCIENCE LINKS and four “assessment writers.” There are, however, no assessment writers credited in volumes 11, 12, 13, or 14.

Some of the early volumes are excellent. The quality does not persist through the final volumes (even the index has multiple errors) where we found that editorial people did the work. That a name is on a given volume does not mean the listed author made a contribution to that book (although in the early books that is more apt to be the case).

There is no program to correct errors. Earlier printings and editions of Prentice-Hall's EPS p. 662, and PHS, Vol. R p. 86, and SE, Vol. O p. 118 had prisms bending light in two directions. Some of it was bent the way Isaac Newton described, and some of it was bent away from the prism's base in the opposite direction. Later printings within most recent PH editions (1999 and 2000) replace those errors, and there are fixes on the web (though it's still not quite right). SCIENCE LINKS on the other hand (Vol. 7 p. 60) has a prism refracting light in

the wrong way (along with other improbable implications) and will wait for the next edition to fix it.

SCIENCE LINKS has a globe illustrated in Vol. 14, p. 11, and the equator goes through Tucson, Texas and Tallahassee. They'll wait for the next edition to fix it.

Integrated Science, Carolina Academic Press, 2000 (and others)

Arguably North Carolina's most famous view is that of the Cape Hatteras Lighthouse. In the 1990 edition they flopped a photo L/R of it on the back cover of Book Two. In 1995 it is properly shown on the front cover of Book One. In 2000 (the year the lighthouse reopened to the public after moving it away from the surf line) it is again flopped L/R on the front cover of Book One, PATTERNS AND CYCLES, North Carolina's 6th grade text. Imagine how reliable the science is going to be! The source of the photos is not shown. NATIONAL GEOGRAPHIC May 2000 gets this right.

I (HPL) asked to talk to someone about errors, and on May 16th (2000) they said that they'd have an author talk to me. It's July now. They said that there is a web site for corrections that are posted each August but I haven't found it yet. CAP's page for INTEGRATED SCIENCE is <http://www.sci2k.com/>

Book One on page 111 and Book Two on pages 54-55 both include periodic tables of the elements. The 1990 book lists 107 elements and pledges allegiance to IUPAC in referring to elements 104 through 107. 1990 on p. 51 has an alternative table showing 103 elements. Enigmatically hydrogen is discussed as an alkali metal on page 46 and as a non-metal on p. 48. Perhaps that's because each periodic table in the 1990 book lists hydrogen twice - once on the top-most left and again next to helium on the far right on the top row. The 1995 book (presumably more up-to-date) lists 106 elements (lost one!), and also uses the IUPAC names for elements 104 through 106. More progress is made in that the doubled hydrogen is gone. The rest of the world, which has been ADDING

elements at an irresponsible rate, does not match North Carolina's progress over those five years. #107 was synthesized in 1981 (per multiple sources including TIME ALMANAC 2000), and #108 in 1983. North Carolina should be really careful in selecting new books. There were 115 elements known in 1999.

INTERACTIONS AND LIMITS, 2000, ISBN 0-89089-778-6 lists 112 elements on periodic table on pages 186-187. There is a note that says, "Element names conform to the current usage of the International Union of Pure and Applied Chemistry at the date of publication." Page 181 says, "Scientists are now experimenting to create - a new element 114." From this evidence it becomes apparent that this material was written before element 114 was synthesized in January 1999. None of those tables were ever true in those copyright years. 109 was true from 1983 to 1994. There were briefly 112 in the mid '90s, but numbers 114, 116 and 118 were synthesized in 1999. This sort of thing is a risk to all publishers who inflate their copyright dates and are behind on their knowledge. A paragraph about the dynamic changes would be much more instructive.

None of this, of course, is an important physics consideration! At this level it would be best to simply present the table with established elements and some note about the possibility of additional elements being produced in the laboratory. A few comments on whether the element is a solid, liquid, or gas at room temperature would also be appropriate. Boiling points, freezing points, densities, color, hardness, and other macroscopic properties would be much more interesting to Middle School students. To use a supposedly up-to-date Periodic Table as a selling point is ridiculous.

CAP does not print teacher editions. There's a CD ROM that goes to the teacher upon adoption. It was not reviewed. Carolina Academic Press's INTEGRATED SCIENCE is a three-volume set, published in editions at 5-year intervals. The set is intended for Middle School, grades 6 - 8.

Book Two, copyright 1990, ISBN 0-89089-360-8, has a prism that disperses white light into a spectrum in an impossible way on page 169. In fact, what this

prism would do (aligned this way) would be to reflect light off its horizontal base exactly like a plane mirror placed where the prism's base is. The incident light is perpendicular to the one slanted plane of the prism, and the outgoing light is perpendicular to the other slanted plane.

Book One, copyright 1995, ISBN 0-89089-590-2 has a much better prism/spectrum on p. 465, but still wrong. It also offers more information on the electromagnetic spectrum on page 332, where it shows a spectrum of the Sun's radiation. The gamma radiation is graphed as some sort of oscillation impossibly reversing itself. Also, the ultraviolet portion of the spectrum is shown next to the red end of the visible spectrum, and the infrared is shown next to the violet. This can only be ascribed to ignorance or carelessness on the part of whoever prepared this illustration. It's the visible light part of the spectrum that is backward. The wavelengths should be radically different and they are not. By 2000, PATTERNS AND CYCLES, p. 96, the funny gamma oscillation has been altered into a plausible sine wave but the ultraviolet remains by the red and the infrared remains by the violet.

PATTERNS AND CYCLES, copyright 2000, ISBN 0-89089-775-1 fixes this spectrum on page 96 so each identified frequency has its own different wavelength. All the waves are now more traditional sine waves. However, the ultraviolet and shorter waves are still on the red side of the visible spectrum and the infrared and longer waves are on the violet side. On page 306 X-rays are described as having the shortest wavelengths even though on page 303, it is clear that gamma rays do. The prism on page 211 and page 323 has been improved, but is still wrongly depicted. Speed and frequency are equated on page 303. There is still some work to be done here.

In Book One, page 344, the eclipse explanation shows the Moon's umbra with an impossible geometry in relation to the Sun. The umbra comes to a vanishing point just before it touches the Earth. No shadow touches the Earth. No shadow - no eclipse. PATTERNS AND CYCLES, 2000, ISBN 0-89089-775-1 uses a slightly larger version of the diagram, and again no shadow reaches the Earth. The geometry of the lunar eclipse is a bit closer to accurate, but not there yet. The

student is asked if he has experienced an eclipse and is to write a story about his feelings.

Book One, 1995, flashes a number of brand names including Pepsi and V8 on p. 71, Glad-Lock bags on p. 78, Eckerd, Revco and Kroger on p. 137 and BP on p. 447. Book Two, 1990, flashes Pepsi on p. 51, Phillips p.76 and Arby's on p.128, Kawasaki on p.134 and Slinky on p. 137. There are a few cultural universals in children's' brains, and Oreos might be one. Maybe Oreos might be a good linear measuring unit. PATTERNS AND CYCLES 2000 lists Casio on p. 24, Pepsi on p. 73, Juicy Juice on p. 74, Pledge, Keebler and Wesson oil on p. 79. INTERACTIONS AND LIMITS 2000 lists Coke and Canada Dry on p. 12, Pepsi on p. 205, Wilson Athletic Equipment on p. 355, Pall Mall on p. 374 and Drano on p.149. Students will certainly connect science with the everyday world! Is there is a policy on this?

One thing that is absolutely excellent is Chapter 10 in Book One 1995 which does everything an Integrated Science text should do for 6th graders. It covers the Honeybee: its life cycles, its history, its evolution, its foraging, its egg laying, fertilization, the role of drones, etc. etc. etc., and its niche in the various ecosystems, histories, etc. etc. Then the physical science, temperature, melting wax, granulating honey, the honey industry, beeswax, bee pollen, propolis, etc., are covered. This chapter and a bee window, observable from the inside of the classroom would cover an enormous amount of all of the disciplines involved. Unfortunately, the bees are gone in 2000.

Some responsible, intelligent and creative people wrote the bee chapter. They were needed for the physical science in the rest of the book.

Book One, page 12, has a discussion of the Global Schoolhouse. What is pictured is a communications satellite, presumably in geosynchronous orbit, being listened to by three satellite dishes. The satellite is parked (as nearly as can be determined) directly above Iceland. One dish in Brazil points slightly east of north to focus on its signal. A second dish in Kansas points to the northeast to the same satellite. A third dish in Egypt points nearly north to the same satellite. This diagram has to be changed. If the satellite is to be "tracked" by a stationary dish that orbit must be pretty close to the Earth's equatorial plane.

I'm (HPL) writing these brief notes on the date of the change to daylight savings time. I was brutally awakened a full hour before my habit, forced to eat before my system was ready for food, had to perform in a political situation (conducting a choir) a full hour before my body was prepared to think, forced to stand and deliver a full hour early to provide the keyboard music for a church service, and now I'll have to go to bed much earlier than my body's clock is prepared to handle. Tomorrow will be nearly as inhumane. Daylight savings time is far more dramatic to a sixth grader, affecting him physically, than an eclipse. The factual causes/reasons of/from daylight savings time involve knowledge of many of the same phenomena. It would be much more appropriate and meaningful.

The electrical circuits on pages 198 and 199 in Book Two show electricity flowing when the switches are open. This is fixed on page 330 of 2000 **CONSTANCY AND CHANGE**, ISBN 0-89089-781-6. The current is described as "flowing" whereas it is the charges that flow. A "current" is "a flow of charges."

Page 166, Book Two, labels center of curvature for convex mirror at about 3 focal lengths from the surface of the mirror. Convex mirrors do not appear in the 2000 series. Page 155 of Book Two, 1990, has a misplaced virtual image. This is redrawn but still wrong on page 312 of 2000 **PATTERNS AND CYCLES**. (As is usually done, the line from the mirror to the object is as long in whatever system of perspective or measurement used as the line from the mirror to the image.)

Book Two reverses the photo of a lab-coated male on page 7, and Benjamin Franklin has his buttons on backwards on p. 220. Is he known to have been left-handed? Good project; perhaps he just dressed in a hurry.

Science Plus: Technology and Society Annotated Teacher's Edition, Blue Level, Holt, Rinehart and Winston, 1997

For a change of pace we will use this book as an illustration of what the reviewers mean by "the busyness of the book" and the overwhelming number of topics. Our

comments apply equally well to the other texts, just as this book is equally rife with errors.

This is an integrated series. There are eight units that integrate physical, life, and earth science. There is an extensive introduction in the “Owner’s Manual” to help the teacher understand the philosophy of the book. There is also an extensive “Assessing Student Performance.” These first pages provide a discussion about “Guiding Principles” of science – “Anyone can learn science” and “Science is a natural endeavor.” This is common in all the latest books. Each just uses its own verbiage. Another aspect of this “Owner’s Manual” is the “Aims” of the book. Once again the same old aims that have been pushed for the last ten years are repeated. There is an extensive section of constructivism. It breaks it down into four key steps, which oversimplifies the concept. After the discussion of constructivism there is a conceptual framework chart that displays content focus, supporting content, thematic focus, STS, process skills, and a process skills focus. There is an entire science education class in the “Owner’s Manual.” This is truly meant to be all things to all teachers! Next comes the “Components of SciencePlus.” You name it; they have it! There are units, chapters, lessons, ScienceLog, explorations, assessment, special features, sourcebook, and annotations! If this were not enough, there are home connection, chapter worksheets, unit worksheets, SourceBook worksheets, transparencies, Getting Started Guides, Assessment Checklist and Rubrics, Materials Guide, Test Generator, English, Spanish audiocassettes, Videodisc Resources, SnackDisc, and more! After the first thirty-three pages, there is still more help! The teacher is exposed to ways to use themes in science, integrating the sciences, cross-disciplinary connections, science, technology, and society, communication science, journals and portfolios, concept mapping, cooperative learning, process skills, critical thinking, environmental awareness, multicultural instruction, meeting individual needs, materials and equipment, scienceplus, and the teacher’s network.

The “manual” is now on page 56 and there is no science yet!

Just as the teacher is exhausted, there is a huge section on assessing student performance. There are the whys, the hows, and a rubric for reports and presentations, experiments, and technology projects. The teacher is now on page 64 and really doesn't know what the book covers, just how to do it!

First impressions are very important for students. The first impression of the student's book is a section called "To the Student." This is really very unexciting. The pictures are good, but the style is really corny. The safety section is necessary and seems complete enough to meet most guidelines. There is a discussion of concept mapping and an example of how to make a concept map. The topics: states of matter and circulatory system will not get the student's interest.

Finally, there is some science. The eight units are "Life Processes," "Particles," "Machines, Work, and Energy," "Oceans and Climates," "Electromagnetic Systems," "Sound," "Light," and "Continuity of Life." There are 555 pages in the student's book. With the average school year being about 180 days, this is about 3 pages per day, everyday! This does not seem like a lot of bookwork, but don't forget the labs, projects, integration, worksheets, and all of the other ancillaries!

Daily Lesson Plans for Unit 7 "Light"

Chapter 19 "The Nature of Light"

Day 1 - "Introduction "pp.422-423.

Discuss why light is important and what the world would be like with no light. Give the students several minutes to brainstorm and then discuss their ideas. Have the students read p. 423 and study the picture on pp.422-423. Show some clear quartz and have them see how light behaves when it hits quartz crystals. Assign pages 424-427 to read.

Day 2 - "The Nature of Light" pp.424-427. Set up Activity 1-5 for Light Brigade; divide class into groups of 4 for cooperative group work. Have the students do each activity and write the answers to the questions in their ScienceLog. Give

each group about 7 minutes to work at each station. After all students have explored the 5 activities, discuss the activities. This will take about 45 minutes. Homework: Keep a list of all light emitting objects the students see in one day.

Day 3 - Review yesterday's work. Discuss p.427. Complete Activity Sheet #1. Read pp. 428-430 'Light, Heat, and Color.' Writing question: p.427 in teacher's edition.

Day 4 - Exploration 2 - Complete lab sheet. Once sheets are discussed and questions answered, turn in to teacher. Complete "A Light Quiz" and turn in. Complete the section from page 430 in the ScienceLog. Activity sheet #2. Homework - Read pp.431-436.

Day 5 - Discuss Activity sheet #2, do math practice worksheet p. 16 for integration, and start the next section. Start Exploration Activity #3. This will take 2 days.

Day 6 - Complete Exploration Activity #3.

Day 7 - Discuss the exploration activity. Discuss p.434. Student groups will prepare the Multicultural Extensions, Environmental Focus, or Language Arts activity (Note: There is no real science being learned here!) to present on Day 8. Homework - choose one or more of the activities to try at home. Be sure each student in the group picks a different activity. These will be presented on day 8 with the other reports.

Day 8 - Reports from integration and activities at home. Discuss 'Light and Color' on p.436. Read pp.437-441.

Day 9 - Discuss "Adding and Subtracting Color". Complete demonstrations.

Day 10 - Review and Jeopardy

Day 11 - Test

Notes: The book recommends that this chapter be done in 7 days. 11 days may be pushing it if you are to integrate the materials and do most of the activities. The exploration activities call for some equipment that some teachers will have trouble finding or using. It would be much better to use something like the Bill Nye video "Light and Color" for this chapter. It would also be much more instructive to incorporate several of the experiments from the Optical Society of America's Discovery Light kit. These will get the students thinking and working with their hands, which is what we expect in a good Middle School program. Finally, it would take at least 15 days to adequately cover this chapter. Is it appropriate to teach color before teaching "How Light Behaves" which is the next chapter where color will have to be redone?

Chapter 20, "How Light Behaves"

Day 1 - Return test and have students respond to the science log questions on page 442. This should help understand the student's misconceptions. Have the students read p.443 and discuss the materials needed to make a light box. Discuss the terms: scatters, absorbed, and transmitted.

Day 2 - Build a light box. Start the Enlightening Experiences by doing Part 1. Keep a record of the answers to the questions in your ScienceLog.

Day 3 - Continue with Enlightening Experiences by doing Parts 2, 3, and 4. Keep a record of the answers to the questions in your ScienceLog. Do Part 5 for homework.

Day 4 - Pages 447-449. Discuss these pages and introduce the terms: transparent, translucent, and opaque. Also discuss the questions on page 449. Have the students ask 3 friends, not in the class, or relatives the 3 questions on p.449. Write down their answers.

Day 5 - Discuss what others thought about the 3 questions. Do other people have

misconceptions? How could you help them? Do the milky water demonstration on p.448.

Day 6 - Discuss pages 450-451. Start Exploration 2 – Pinhole Images. Assign *camera obscura* for a research assignment. Brief report due in 2 days. Use a rubric to show students what is expected. Use the Exploration worksheet with this activity.

Day 7 - Complete the Exploration. Have the students develop 3 quiz questions and answers from this lab. Discuss the lab and have the students quiz others with their questions. Remind students that the *camera obscura* is due the next day.

Day 8 - Discuss Reflection (finally!). Do Exploration 3 and answer the questions in the activity.

Day 9 - Complete the activity. Be sure students know what diffuse reflection, incident beam, reflected beam, and specular reflection are. Have students find out how mirrors are made for homework.

Day 10 - Discuss how mirrors are made. Assign pages 456-459 to be read. (Here is color again!)

Day 11 - Discuss color noting the difference in light and paint. Start Exploration 4 - Changing colors. Integrate art and color mixing here with the art teacher.

Day 12 - Have students make color filter viewers and use them at home and keep a list of color changes they see in objects.

Day 13 - Write the answers to the challenges on pages 460-461 in the ScienceLog. Use Activity worksheet that goes with this.

Day 14 - Review and Jeopardy

Day 15 - Test

This does not leave time for another Bill Nye or OSA's Discovery Kit experiment. We still haven't talked about images. This is much too late to introduce images. The students should have this much earlier and have it reinforced throughout the light unit!

Chapter 21 'Light and Images'

Day 1 - Discuss the test. Have students read pp.462-463. Discuss the terms: image, plane mirror, real image, and virtual image. After the discussion start on Exploration 1. Homework: Have the students find out how Leonardo daVinci wrote his notes.

Day 2 - Discuss Leonardo's writing style. Complete Exploration 1. Discuss checking the facts. Have students work in groups and decide on what would make the fact correct if it is incorrect. Discuss the difference between real and virtual images. Homework: Have students find two symmetrical 'half-words' that become full words when reflected by a mirror.

Day 3 - Use toys that use mirrors, such as Reflecto™, or a periscope and explain how the toy demonstrates the concepts studied. Have each student show a toy and discuss the physics of the toy.

Day 4 - Discuss convex mirrors and do Exploration 2. Write the answers to the questions in the ScienceLog to be discussed the next day. Have the students look at different convex mirrors and discuss of the curvature effects the field of view.

Day 5 - Discuss converging lenses and real images (lenses at last!) Do Exploration 3. (This is opposite to the way OSA introduces light. Lenses are introduced early on to take advantage of their familiarity.) Present the students this problem for thought: you want to start a fire, but only have a magnifying glass and paper. How do you do it? Try different paper; what happens?
SAFETY!

Day 6 - Discuss the eye and how it works. Discuss how you see. Ask the students: How do you see a tree? Have them draw a picture. This will show many misconceptions that students still have about light.

Day 7 - Real images and concave mirror - Introduce concepts and then do Exploration 4. Remember to write answers in your ScienceLog.

Day 8 - Complete the activity and write up. Have students research the history of eyewear. Also have them find out how lenses help them see better.

Day 9 - Discuss findings about ancient eyewear. Demonstrate how lenses help people see better. For a small group activity, have the students think of all uses of concave lenses and explain them. Share these ideas with the group before the period is over.

Day 10 - Have the students read the top of p.477. Discuss refraction and talk about total internal reflection. Have the students do Exploration 5. After they have filled out the ScienceLog with answers to the questions, have them interpret their findings using the information on page 479.

Day 11 - Bill Nye on Optics and general review.

Day 12 - Challenge your Thinking - Have teams of 2 work on these questions. All students should write the answers in their ScienceLog. Have the class share ideas. Have each student revise his or her answers for homework.

Day 13 - Jeopardy - review for test

Day 14 - Test on chapter.

Day 15 and Day 16 - Complete the unit with the Making the Connections activities.

A great deal of this material can be thrown out. Naming a phenomenon before actually observing it is a serious mistake and it is done frequently here. It would be much better to carry out the OSA's experiments and have the students describe their results. Dissecting a throwaway camera would teach some of this science in a much more meaningful way. This experiment shows a very good practical use of lenses. This is no way to teach light. The order is all wrong! In an effort to be "different," the book has totally scattered the materials in an illogical sequence and has crammed much about light in a unit that is to be taught in 20+ days whereas in reality it would require at least 45 to do it justice. "Less is more" has not been a guiding principle in this case.

The actual physics isn't too wrong. The order in which the concepts are introduced is. There is really no teaching of concepts. Students are supposed to explore and learn the concepts. More often than not, they will pick up incorrect concepts. Photons are mentioned in chapter seven while discussing the atom, but never discussed in light. (Studying the internal structure of the atom is a serious mistake at this level, but since it has been introduced, it would be appropriate to follow through here.) In an effort to be different, the "authors" have taken a very good and interesting topic of physics that Middle School students like and can handle and messed it up. They, in the process of being all things to all subjects and standards, have really developed a messy light unit. For example, the eye is introduced in one lesson and then later, farsightedness is mentioned.

Most books introduce light in general, reflection, refraction, lenses, color, and diffraction and interference. This order builds on previous concepts. Students can easily see the difference in mirrors and lenses as far as concave and convex are concerned. This book just mixes it up. If all the concepts were to be accurately taught, integrated into other curricula in science, mathematics, and other areas, this unit would make a semester of work. In Middle School, that would be considered too long on one topic. (In fact, it would be much better to teach fewer topics in more depth!)

After reading the unit, analyzing it and working with some of the explorations, it

is definitely squirrely. The teacher will always be looking for materials (nuts). It is similar to the old Addison Wesley elementary series of the early 1970s. That was supposed to be all things to everyone, but it was test in treasure hunting for the teacher!

A good Middle School science text should allow for some class lecture/discussion (15 minutes/day), some exploring time (more), and some follow up and follow through (more still.) Middle School is a transition between elementary and high school. The students need a combination of lecture/discussion and exploring. If left only to explore, they will not learn science. This needs to be monitored.

Focus on Physical Science by Charles Heimler & Jack Price, Merrill Publishing Co., Columbus, Ohio, 1989

General Notes on the book:

The pink highlights in the text are helpful and the ‘Planning Ahead’ section in the teacher’s notes is a good idea. Having a piece of the time line in each unit might confuse students into thinking that the science presented in each unit was developed during the time listed in that piece of the time line. It would be better to have the whole thing at the back or front of the book or perhaps separately discussed. It is an interesting feature.

It is very difficult to understand anything about electron shells (a topic best left out of the Middle School/Junior High curriculum) based on the information in this book. That entire chapter needs to be rewritten with the fact in mind that most teachers will not have a strong background in chemistry (most probably did not even take a college freshman course.) The book assumes far too much knowledge in this area on the part of the teacher. In general, in the books that we have looked at, this topic presents diagrams in which it is not clear that by volume the nucleus of an atom is extremely small compared to the volume of the atom

whereas by mass the nucleus is extremely large compared to the mass of the atom. With the particular drawings used a student will come away thinking that the volume of the nucleus takes up most of the atom.

The book in general does not do a good job of explaining what is likely to happen in a lot of the demonstrations and experiments that it describes. Most teachers will not have performed a lot of these demonstrations and experiments and may have no idea what to expect, and they will have no idea whether or not they are doing it correctly.

However, the level at which this book was written would be more appropriate as a resource for teachers and this is what we found most teachers using it for. The problems can be fixed.

Notes on the Teacher Resources described at the beginning of the text:

The “Challenge” sheets to “encourage your better students to use higher-level thinking skills” are worthwhile. There is a rich assortment of worksheets that focus on different areas (reading comprehension, mathematics, laboratory observations, etc.) Unfortunately, the exams focus on memorization skills rather than thinking skills. The list of information sources for teaching special needs students is a nice addition. The list of equipment would be more useful if all the equipment needed for each separate lab activity were listed.

Unit 1 Physical Science Fundamentals

Chapter 1 The Nature of Science

p. 10 One of the review questions states “Determine how the blood circulation system is a model for the refrigeration cycle in a refrigerator.” How many students will be able to describe the refrigeration cycle?

p. 18 The teacher notes suggest having students “write an experiment that will answer the question ‘How can you separate ripe tomatoes from unripe tomatoes,

without relying on the color...?’ Students may not cut or damage the tomatoes.” This is ludicrous. Do the authors honestly think the students will come up with the fact that ripe tomatoes float?

p. 20 The “super sand” example states that the type of sand is the independent variable, because it is “something you can change in an experiment.” However, water was also used in the experiment, and the amount of water could have been changed. Students may find this point confusing. Then, in the next experiment description, it states that the outside temperature is the independent variable. In this case, it could *not* have been changed by the experimenter. The explanation of what “independent” means needs some work.

Note: There aren’t many hands-on activities in this chapter and this is a drawback.

Chapter 2 Physical Science Methods

p. 24 The lead-in discussion example of the English vs. the apothecaries’ ounce is an interesting way of leading to the general problem of varying definitions of units, but perhaps a more common unit such as the yard would be more appropriate. Also 1 kilogram does not equal 2.205 pounds; it weighs about 2.2 pounds. Confusing mass and weight this early will present problems later.

p. 27 The diagram about precision may confuse students into thinking that metal rulers are always more precise than plastic ones. Why is there a difference of materials for the two instead of just different division sizes?

pp. 27-28 The discussion of significant digits is confusing. Why not simply list a set of rules? The examples are pretty vague. (There should at least be more of them if rules aren't going to be listed.)

p. 29 The comparison stating “Using SI is as simple as using the United States

money system” is odd, and seems to somehow imply a conversion of multiples of ten for units of our money.

p. 32 The “step chart” for making unit conversions is a good visual explanation, but listing the SI prefixes here would be better than in an appendix.

p. 44 A graph of pendulum data is shown. The data is simply given to the students. Why not have the students take this data themselves? The graph will not turn out perfectly as the one in the text does and will teach an important lesson about gathering data.

p. 45 The directions for the “making a Hydrometer” activity are much too vague nor is it clear that should one be made, how it would be used. The teacher’s notes are no help.

Note: The emphasis on mathematics skills and more hands-on work in this chapter is a definite plus.

Unit 2 Force and Energy

Chapter 3 Motion

p. 56 The definition of rates, “ratios between two different quantities” seems odd. (The teacher’s notes state that 4 tires/car is a rate.) A better definition would include a change in some quantity over a change in some other quantity.

p. 57 The inclusion of problem-solving techniques in the example problem is good, but the formula for speed should read that speed is equal to the distance covered divided by the time taken.

p. 59 The graphing exercise asks the student to draw a smooth line through the data given. Students should be told that a line in this context might not be

straight. A “best fit” line should be described.

p. 60 Most books reviewed described time rates of change without making it clear that they were time rates of change. Acceleration is the rate of change of velocity with respect to time.

p. 66 The caption on the figure confuses Newton’s 2nd and 3rd Law.

p. 70 Here we have another “medium-sized apple” with a mass of 0.1 kg! While some apples do have such small masses they cannot be described as “medium-sized.”

p. 72 The “Measuring Force” activity directions are unclear. It was not obvious that the student was to measure the weight of the marble, etc., in units of washer weights. What size washers are to be used? Some small washers weigh more than a typical marble.

p. 73 The book has an example of stretch as a function of applied weight for a rubber band. It seems to imply that this data can be applied to the student’s own rubber band. Better to have the students generate their own data, after all, this is easy to find equipment. On the same page Galileo is credited with showing that the Earth is not the center of the Universe. While he certainly promoted the idea, he did not have sufficient evidence to prove it.

Chapter 4 The Laws of Motion

p. 82 The book states, “If you calculated the acceleration of a ball falling in a vacuum, you would find it to be 9.8 m/s^2 .” The authors do not define a vacuum until the following page, nor do they make it clear that this is true only near the surface of the Earth. On the Moon, the acceleration of a ball falling in a vacuum would be 1.6 m/s^2 . This experiment can be done using the video of the astronaut dropping objects on the Moon.

p. 88 This is good background on the fictitious “centrifugal force” for teachers so as not to fall into the trap of using the term.

p. 89 The “Studying Skills Assignment” is very good. All teachers should assign this activity.

p. 90 The term “weightlessness” is a misnomer and should not be used here although the text does straighten out the usage. It confuses students and leads them into thinking that there is no gravity acting on the shuttle or out in space.

p. 90 The insert about particle colliders seems oddly placed in this section on gravity.

Chapter 5 Energy

p. 103 The diagram and explanation of Figure 5.3 seem at odds with one another. The explanation states “Work is done on the box only when it moves in the direction of the applied force,” but the diagram shows the force and motion in perpendicular directions.

p. 104 The problems should be more specific about work done by which force. Example: Problem 2 asks “A 1.0 kg mass is lifted 100 mm ...as it moves 350 mm horizontally. How much work is done?” Work was done both by this lifting force and by gravitation.

p. 112 Again, another technology insert seems oddly placed. The “slingshot effect” of planets giving spacecraft greater kinetic energy is placed in the middle of the thermal energy discussion.

p. 112 The way the units are written for specific heat are confusing. It looks as if it reads (J/kg) C rather than J/(kg C).

p. 113 The book says that change in temperature can be either $T_f - T_i$ or $T_i - T_f$. This is a bad habit to teach students.

p. 113 The demonstration listed calls for pouring hot water and hot lead shot onto two votive candles (which are in beakers) and comparing how much wax melted. It is unclear how students are supposed to do this comparison. Do they empty the beakers?

p. 115 Problem 5: It is difficult to tell to which example the text refers.

p. 115 Teacher's notes: It would be better to state that energy, rather than work, is conserved.

p. 117 The text states, "An object that is bent or squeezed...has potential energy" which is not always true. If I bend a paper clip, it does not have stored energy as a result of squeezing.

Chapter 6 Heat in Our World

p. 122 One sentence on this page is very confusing. It states "...and no energy at all can be conducted across a vacuum." This is true, but energy can be *radiated* across a vacuum. Two paragraphs later it states "Radiation is a transfer of energy that does not require matter. You have felt the warmth of the Sun. The source of this energy is 150 million kilometers away, with mostly empty space between." Students may not see the subtle difference here.

p. 123 The "convection vane" activity directs students to put a paper spiral on a light bulb – two words: FIRE HAZARD!

p. 131 The "Cause and Effect" statements seem a little careless. Example: Cause: "Fiberglass and plastic are good insulators." Effect: "Coolers are made of

fiberglass and plastic.” This is not a direct cause/effect relationship.

Chapter 7 Machines

p. 149 The photo included to illustrate a third class lever is that of a baseball pitcher. How does this illustrate a lever? A superimposed graphic would help. The teacher’s notes suggest describing a player hitting a ball with a bat, which makes more sense. Why was this photo chosen?

p. 156 The teacher’s notes use the abbreviation IMA without defining it.

p. 157 Industrial engineer Lilian Gilbreth’s husband’s name (Frank) is mentioned without first letting the reader know who he was.

p. 160 The pencil/ruler lever activity would work better if the ruler were taped to the pencil.

Unit 3 The Nature of Matter

Chapter 8 Solids, Liquids, and Gases

p. 170 The photos illustrating solids and liquids are reversed.

p. 172 The “collapsing a can” activity often will not work unless one uses ice water for submerging the can opening.

p. 172 The directions in the teacher’s notes and the student book about the Bernoulli’s Principle demonstration conflict.

p. 174 The example given in the teacher’s notes states that hard candy is a

material that does not form crystals would be confusing to students. Some candies do form crystals.

p. 190 The graphing exercise of temperature as a function of time for melting ice cubes in water is good, but the teacher's notes have a graph that was not obtained experimentally. The explanation as to what should occur is qualitatively correct.

Chapter 9 Classification of Matter

p. 197 The matter diagram is clear but could be improved with an example in each box.

p. 201 The activity refers to a filtering technique described in the book's appendix. The appendices are very good – easy to follow with clear illustrations.

p. 205 The teacher's notes use the unit abbreviation M without defining it. ("Test tube 1 contains 6M HCl.")

p. 207 The teacher's notes should include an explanation of the chemical reaction that occurs in the activity.

p. 208 A statement in the teacher's notes ("A substance undergoing electrolysis must be molten or in solution so that it can conduct a current") seems to imply that a solid (such as copper wire) could not conduct a current.

Chapter 10 Atomic Structure and the Periodic Table

p. 215 Attempting to specify a total of 109 different elements is a mistake. It is well known that new nuclei are being put together in the laboratory. It would be much better to describe the situation by pointing out that there are naturally

occurring atoms plus some artificially produced atoms and the on-going work of physicists to produce ever-heavier atoms.

p. 218 The statements “Atoms are neutral...atoms have no overall electric charge” are correct, but it would be wise in the light of the discussion on chemical bonding on p.242 to point out that atoms can gain and lose electrons and become ions.

p. 223 ‘Predicting an element’s group and period” activity is confusing. The explanation for “group” assignment is extremely vague in the teacher’s notes. The answer for Question 6, for example, isn’t clear.

p. 224 Question 5: Why is Level 3 again assigned 8 instead of 18 electrons? Are the $2n^2$ rule on p. 219 and the energy level diagram on p. 220 incorrect?

p. 228 The Periodic Table has “actinoids” and “lanthanoids” instead of “actinides” and “lanthanides.” Chapter 12 continues this use.

p. 233 Clue #3 for placing fictitious elements in a periodic chart is rather vague. There is nothing in the clue to suggest that they belong in the first column.

p. 236 Problem 18 states that the maximum number of electrons in level 3 is 18.

General Note: The book answers are correct. However, it would be very difficult for any teacher without a rich background in chemistry to figure out these problems with the information given in the chapter. Most teachers will not have the advantage of such a background, nor will they likely have colleagues who can help (or time to research). The book needs to do a much better job here explaining electron shells and how they are filled, at least in the teacher’s notes. Why such material is included in a book at this level is another concern.

Chapter 11 Chemical Bonds

p. 240 The book states “sodium chloride is a white crystalline substance we use to season our food,” should add, “commonly called ‘salt’.”

p. 240 The definition for subscript, “a number that shows how many atoms of each element combine to form a compound,” may be confusing to students who are using subscripts in math and English classes in other ways. A better way to state it would be “A subscript used in a chemical formula shows...”

p. 244 How are students supposed to figure out whether or not atoms will form an ionic or covalent bond from the information provided?

p. 245 The difference in the two types of bonds is not explained very well at all.

p. 246 The illustration of the charges on a water molecule is confusing – it appears to state that electrons are positively charged.

p. 254 The text does not explain why some compounds end in –ate rather than –ide.

p. 254 The example for determining oxidation number for S in SO_4^{2-} results in an oxidation number for S of 6+, which seems to contradict the chart value of 2- on p. 251.

Note: These last two chapters are generally very confusing and contain information that is totally outside the capability of Middle School students.

Unit 4 Patterns of Matter

Chapter 12 Elements in Groups 1 Through 12

p. 265 The book keeps referring to the periodic chart, which is located in Chapter 10. It would be much more convenient to have the chart on one of the inside covers.

p. 265 The word “metaborates” is used without definition in the teacher’s notes.

p. 273 In one paragraph the book states that radium is used to treat cancer and that it causes cancer. Perhaps a little explanation here about targeting cancer cells, etc., would make this less confusing to students.

p. 275 Figure 12-8 shows someone nickel-plating, but the reader will have no idea what the objects in the picture are. They look like little Christmas trees.

p. 276 The objective of the activity, “to make several different transition metal compounds...relate changes in color to changes in composition,” seems at odds with the directions. Of six observations, only three involve adding a new solution. So, one half of the color changes are due to temperature changes (which actually are due to losing/gaining water). The students will not understand this subtlety.

p. 279 The text uses the word “synthetic” (in relation to elements) without defining it for the students.

p. 279 Two full paragraphs are devoted to the discussion of “lanthanoids”, yet the “actinoid” section states that these elements “are radioactive and have little use beyond atomic weapons and nuclear power. These uses have created much controversy. Some nuclear reactions of uranium are discussed in Chapter 23.” Is this the best they can do? The harnessing of nuclear power is one of the *defining* scientific achievements of the twentieth century. Radioactive materials have a host of important uses. Are the authors so anti-nuclear that they refuse to even offer a brief description of the characteristics of these elements?

p. 281 The following reaction is used in the teacher’s notes: $2\text{CuO}(\text{cr}) + \text{C}(\text{cr}) \rightarrow$

$2\text{Cu (cr)} + \text{CO}_2 \text{ (g)}$ The terms “cr” and “g” are not defined until page 367.

p. 282 The discussion about shape-memory alloys is very interesting. It is especially helpful that addresses are included so that teachers can send for actual samples from companies.

p. 283 The qualitative analysis is not well defined at all. Students will have trouble trying to answer the question based on the information given.

p. 284 The teaching activity for learning about flow charts is great – a very useful skill for students to have.

Chapter 13 Elements in Groups 13 Through 18

p. 294 The teacher’s notes say, “students should not be expected to distinguish s, p, and d electrons”. Again, the book seems to assume knowledge of these electrons from previous chapters.

p. 296 A photo is shown of the root of a plant. It’s fairly difficult to tell what the photo is, and there is no sense of scale.

p. 297 The photo here is unclear. Is there soap (phosphates) floating on the water, or is that reflection of light?

p. 306 The word “organic” is used in the teacher’s notes, but no definition is given. The current misuse of the word needs a clear-cut science definition.

Chapter 14 Carbon and Organic Chemistry

p. 317 The text uses the terms “single, double, ...triple covalent bonds” without first defining them.

p. 320 The text uses the words “planar” and “linear” in describing molecule

shapes. The students will not understand these words in that context.

p. 321 It is not clear in the directions of the organic molecules activity that several models are being made. Perhaps the instructions for each model should be separated somewhat (or renumbered beginning with Step 1 each time.)

p. 322-323 A lot more explanation would be needed to handle this topic here.

p. 329 The naming rules for hydrocarbons are unclear.

p. 331 Where is the -COOH (acid) group referred to in the diagram for peptide linkage.

Unit 5 Interactions of Matter

p. 341 Part of the timeline information is incorrectly cropped.

Chapter 15 Interactions of Matter

p. 347 The teacher's notes should explain *why* the cola in the bottle on its side will go flat faster.

Chapter 16 Chemical Reactions

p. 364 The demonstration in the teacher's notes does not include an explanation of what happens during the reaction, which would be helpful to someone who has

not performed the experiment previously.

p. 367 Why is the activity for listing numbers of atoms in chemical formulae listed as an ‘Enrichment’ exercise? This is a basic skill needed for this chapter.

p. 367 It is not clear that the subscripts (and not the coefficients) should never be changed when balancing an equation.

p. 373 The analogy of displacement reactions to dancing (with partners cutting in and switching) is very good.

p. 373 What is the basis of the ‘challenge’ anecdote? What happens to the engines during this reaction?

p. 375 Figure 6-10 is supposed to be a catalytic converter, but it looks like a birdfeeder with birdseed! Are the pellets the catalyst?

p. 375 Teacher’s notes do not state what should happen in the meat tenderizer experiment. (Note: The lack of explanation about what one should expect seems to be a recurring problem in this book, if not for the teachers, then certainly for the students.)

Chapter 17 Acids, Bases, and Salts

p. 387 The directions do not explicitly state that the baking soda should be added to the *solid* and not the liquid from which it was strained.

p. 389 Why are or how are H_5O_2^+ and H_7O_3^+ ‘represented by the general formula H_3O^+ ?’

p. 397 The teacher’s notes for the activity for determining pH by using red

cabbage juice does not state which colors indicate which pH values.

p. 400 Why isn't Avogadro's number put in the student section instead of the teacher's notes? It is an important constant.

p. 400 Are the two burets (burettes) filled with equal amounts initially?

p. 400 In Figure 17-11, the "burets" are nearly invisible. The red holder is a little distracting.

p. 405 Here are the pH color indicators for the red cabbage juice! Why are they not on p. 397, or at least referred to on that page?

p. 406 Why is kerosene used in this experiment (soap and detergent)?

Unit 6 Waves, Light, and Sound

p. 413 Because of the poor cropping of the time line, it states that in 1945, "World War I ends."

Chapter 18 Waves and Sound

p. 418 The authors of the pendulum activity are trying to get the students to release the pendulum from a small initial angle. Their directions, however, are confusing. I'm sure the students will wonder why they must pull the bob 15 cm when the length is 60 cm, 10 cm when it is 40 cm, and 6 cm when it is 20 cm. Why not just have them measure an initial angle with a protractor?

p. 422 The suggestion to "Have students discuss whether there is sound if no one is present to hear it," can lead to some good characterizations of physics that

distinguish it from other disciplines if the teacher is prepared for it.

p. 423 The questions in the activity refer to a caption for Figure 18-9. There is no caption.

p. 425 Most teachers will not know what a “piezzo (sp.) buzzer” is (listed in the demonstration section for Doppler Effect.)

p. 431 It is not clear in the answer to Question 15 *why* sound travels faster in helium gas than in air.

p. 434 On p. 422 it states, “*sound travels faster through warm air than through cold air,*” and on p. 434 it states, “*...but sound travels faster in colder air.*”

Chapter 19 Light

p. 441 The electromagnetic spectrum diagram is extremely confusing. It seems as if yellow light goes from 10^6 Hz to 10^{12} Hz and that blue light covers the same frequencies as yellow and red. Actually, the colors are meaningless. The diagrams of objects on the right might be helpful if placed right next to the wavelength to which its dimensions correspond with the colors removed. There also is no label telling students that one list of numbers is the frequency and the other is the wavelength.

p. 447 The last question/answer for the light/color activity is misleading:
Question: “Can you conclude that your observations will be the same for all colored objects?”

Answer (in teacher’s notes): “No, with your limited experience, you could only conclude it is true for the colors you tested.” While this is true, it does not help explain to students how scientists make conclusions based on experimental results. If we did this experiment 3000 times with 3000 colors and our predictions held true for each, then we would feel very confident about drawing some conclusions about the behavior of light.

- p. 450 There seems to be no difference in color in the “Blue” and the “Blue + green” section of the light color wheel.
- p. 453 The directions to the “Motivation” activity are very confusing. How does making a shallow end in the ripple tank demonstrate refraction? (This activity should be included later, when the explanation is actually given in the chapter.)
- p. 454 The teacher’s notes should include some explanation of what the spectra *should* look like for fluorescent lights, streetlights, etc.
- p. 455 The incident and reflected angles are labeled backwards in Figure 19-16.
- p. 457 The text material on prisms may be confusing to students. It states, “a prism has the shape of a triangle” and then “Rain droplets...act as prisms.” The two statements need to be clarified.
- p. 458 The picture chosen to demonstrate diffraction is not a very good one. It is difficult to tell in which direction the water is moving.
- p. 459 Some teachers may not understand the term “monochromatic light source.” It should be defined.

Chapter 20 Mirrors and Lenses

- p. 466 The directions to the “Skill” activity in teacher’s notes need to be more detailed. How exactly are the students supposed to trace the light rays? What is meant by “reversed”?
- p. 471 In Figure 20-7 it would be helpful to have arrows indicating the direction of the incoming light rays. It would make more sense if the ray diagrams were next to the photos.
- p. 471 The word “flat” is poorly used here: “A thick convex lens will bend the

light more than a thin *flat* one.” The students have already been told earlier in the chapter that flat indicates a *plane* surface. Deleting “flat” would solve the problem.

p. 478 Teacher’s notes answer to Question 2 should be more like 14 cm rather than 24 cm.

p. 479 Whenever dealing with lasers always point out that one should be careful. Although laser pointers are not harmful, there are more powerful lasers that could result in retinal damage.

p. 482 In figure 20-19 it should be more obvious than it is that the incident angle is getting larger in each successive diagram.

p. 482 The photo of optical fibers looks more like fireworks.

p. 489 “Many scientists won’t live near an overhead power line or sleep under an electric blanket” is nonsense. (The article is discussing possible hazards from low frequency radiation, a subject that has been studied very thoroughly and shown to be non-hazardous.) There may even be some scientists who won’t walk under ladders. This topic is totally outside the realm of physics for these students.

Unit 7 Energy Resources

Chapter 21 Electricity

p. 494 In diagram 21-1 it should be made more obvious that there are more positive charges on the rod.

p. 496 Will the teachers know what a “Leyden jar” is (listed in teacher’s notes)?

p. 512 The “Problem Solving” activity (drawing circuits to represent different situations) is a good one for determining the student’s understanding of parallel and series circuits.

Chapter 22 Electricity and Magnetism

p. 516 There is no real explanation of what is in the photo – is this a microchip that runs a computer? Will the teachers know what a Crookes' tube is? Note that this is the correct spelling for the inventor is named "Crookes."

p. 517 The definition of a magnet, "A magnet is any object that can exert a force on another magnet" is both circular and incorrect. *Any* object can exert a *gravitational* force on a magnet without being a magnet itself.

p. 518 It is not clear in the photos of Figure 22-2 which poles are like and which are unlike. (It looks like two different sections of the same photo.) Also the caption suggests that unlike poles repel. Labels would be helpful.

p. 519 It should be stressed that the current in Figure 22-3 is a *negative* one – otherwise the force directions given are incorrect.

p. 519 There needs to be more emphasis on the fact that a charge *moving* through a magnetic field experiences a force.

p. 521 The labels in the photo of Figure 22-6 are very difficult to read.

p. 530 The text on transistors is not at all clear.

p. 531 The numbers in Figure 22-16 are quite small.

p. 535 The directions for the Problem Solving activity (diodes and circuits) are not clear. The solutions in the teacher's notes use symbols that are not defined anywhere.

p. 536 The photo/description of a floppy disk is a little outdated, but that comes with using a rather old text. Regardless, there is a lot of good physics that could

be discussed here.

Chapter 23 Radioactivity and Nuclear Reactions

p. 545 The word “fusion” is used (in the supernova article) before it has been defined.

p. 545 In the teacher’s notes, what do these directions mean: “Have student draw electron diagrams for several isotopic pairs...”

p. 546 The “Motivation” activity in the teacher’s notes should include some notes about what is to be expected in the demonstration.

p. 548 Question 9 is impossible to answer: Question: “Is a radioactive sample safe once it is one half-life old?” Answer: “No.” This question depends on too many factors to be answered that simply. What kind of sample? How much? What is its activity? Where is it stored?

p. 549 It would be nice if this section on carbon dating gave some actual dates and an upper limit to its accuracy. Also, carbon-14 can’t be used to date “rocks and fossils.” The text correctly says later it can only be used on once-living objects.

p. 551 There are no “statements a., b., and c.” in Figure 23-8. Also the statements have two blanks each and only one answer for each is given in the teacher’s notes.

p. 552 The photo has too much glare to show the foil ends of the electroscope.

p. 554 Answers to procedural questions should be given in teacher’s notes for Investigation 23-2.

p. 556 The SSC is old news (no longer being funded) and should be removed from text unless the physics involved could be discussed.

Chapter 24 Energy Alternatives

p. 562 Text should include some note about the photo (or the text on p. 568 discussing the solar car in the photo should reference p. 562). It's appropriate that not much was made of solar cars being practical.

p. 573 Should the paper strip catch on fire in this activity? Teacher's notes don't make this clear.

p. 574 In Figure 24-7 the photo is too dim – can't really tell that it is a dam.

p. 578 It should have been pointed out that the 4000 predicted deaths due to cancer is a very small fraction of the total number expected to get cancer in the same area. The largest dose was received by the Bulgarians and that dose was half what folks in Colorado get naturally. The beneficial effects of radiation are not even pointed out. Drop the background information as unreliable and inappropriate.

p. 584-5 This essay on plutonium should be dropped. The material is questionable and totally inappropriate for Middle School or even high school students without much more background.

Appendix

The appendix has useful instructions for some experimental methods (filtering techniques, e.g.) – very clearly written with good illustrations.

Science Anytime Napoleon Adebola Bryant, Jr., Carol J. Valenta, Gerald H. Krockover, Marjorie Slavik Frank, Mozell P. Lang, and A. Deman, Harcourt Brace & Company 1995

Overall Comments:

The introductory material given in the teacher's edition is much shorter and more helpful than some of the other texts we have looked at. There is still too much in the way of "aids" for the teacher and very little "white space" in either the teacher's edition or the student's edition. Integrating history and vignettes into the text when appropriate is much better than filling up the page with boxes that do not always relate to the text or the science.

The "Projects To Do" section for students comes before the ideas are even discussed. For example, students are told to "make a series of diagrams that show...an oceanic plate collapsing" before they know what an oceanic plate is. This is certain to be confusing. The "Projects To Do", "People to Contact", and "Books To Read" sections should come later.

Science by its very nature is multicultural. There is no need to artificially introduce exercises to illustrate this. An activity such as "challenge students to discover the names of ... other scientists and to make a list of all the different countries they represent" (p. A22) is not science. If a teacher uses this activity to fill up a "science time requirement" then he or she is cheating the children.

There are many interesting and enjoyable specific topics within each general unit of study. The difficulty is that they are not always pertinent nor do they teach science. To call a "jungle" a "rain forest" is not appropriate in a science book. There is a bias in the articles against technology and science and is not always clear as to what science is. If a teacher is concerned about his or her ability, there are worksheets available to fill in and help math and experimental skills.

The teacher's edition contains many notes and hints. Teachers will find several chapters of useful information on both science and pedagogy. The most overwhelming problem, however, is that it is trying to be all things to all people. Multiculturalism is important and teachers have to deal with students with different learning capabilities, different backgrounds, and even different primary languages. This book tries to address every one of those issues. It is supposed to be a science book, not a social studies book! Many of the suggested projects are

worthless from a science perspective and should not take time from science.

Another problem has to do with the directions for the hands on activities for the students. They are not very clearly written and we even found them at times difficult to figure out what the author meant.

Unit A Ring of Fire

Some detailed comments:

p. A14 This is not a photographic essay. The second picture is confusing – it looks as if the gas cloud evolved into many little spiral galaxies before becoming the Sun. More textual material and a less uniform drawing would help.

p. A30 The map is meant to show the Ring of Fire, but is presented in a way such that students won't see the "ring." The map should be centered on the Pacific Ocean.

pp. A30-33 These two activities are confusing. Is stuff falling into or squishing out of the receding plates?

p. A35 Students are told to use paperback books, but on p. A27b, the teacher notes say that magazines should be used because paperbacks won't work. This is sure to frustrate the students who try the activity.

p. A36 The trench should be labeled on the diagram.

p. A37 The teacher's "Think About It" notes don't include any sort of explanation as to *why* one plate would go under another, or why both would go up.

p. A53 The parallel waves to be modeled on this page would be better modeled by shaking a slinky toy forward and backward. The bungee cord will simply stretch and contract. (In fact, on the following page, it shows a slinky!)

p. A58 The paper is going to fall over constantly without a support. It works better if the paper is mounted around a heavy roll of paper towels centered on the record.

p. A59 Question #2 mentions a "base line" without defining what it is. This is a common problem – introducing new vocabulary without a context. See also p. B32 where "biome" is used without a definition.

p. A60 The teachers are not given enough information to answer the "Think About It" question. In addition, the phrase "longer lines" is ambiguous and should be accompanied by a labeled picture.

p. A71 The current most widely accepted theory of dinosaur extinction is that a large meteorite (not a volcanic eruption) caused a blanket of dust to surround the Earth and that killed off the dinosaurs. (Later, on p. B73 it says "the [theory] with the most evidence is that a giant meteor hit the Earth, causing a sudden change in climate.") This would be a good opportunity to introduce something about how scientists handle conflicting theories, but as with all books that we have looked at – they fail to.

Some overall reactions to Unit A:

The science presented is for the most part correct. It's too bad that this series ends at Grade 6. The unit is far too "touchy feely". Too many under-prepared teachers will consider teaching cultural concepts as teaching science.

Maintaining a science log is a good idea to force students to put down ideas in written form and to organize ideas, but ONLY if incorrect assumptions and writing errors are noted and corrected. Science isn't a study based on opinion, but on observation and fact.

Unit B Caution: Endangered Species Ahead

p. B14 It's important for students to get the idea that we do have an organized classification system and each scientist does not make up his or her own scheme.

p. B16 More activities like the "Key to a Tree" activity would be welcome.

pp. B30 31 No explanation for answers is given (for the teacher) for the activity on these pages.

pp. B33 35 The story about a girl who visits the "rainforest" is a very interesting way to present some of the details about a jungle. Occasional diversions such as this one are probably OK, but too many turn the course from science to natural history.

p. B60 The "which bird beak type works best" lab suggests that students will discover that straw type beaks will work best for liquid food. However, the experiment instructions do not ever tell the students to try the lab with any liquids and no liquids are listed in the materials list.

Overall impressions for Unit B:

References to outside reading are an important practice. Besides improving reading skills students come to realize that everything is not included in one book. Stories about real scientists (such as the guy who can identify over 3000 bird species by sound) show that one does need to be committed to one's discipline. Including evolution and not giving in to pressure groups marks this as one of the better books.

Unit C Stage and Screen: Using Light and Sound

p. C24 In the "Multiply with Mirrors" activity, the students are told to unfold the mirrors and stand them upright they won't stand upright unless supported or held there. The instructions are confusing and will be a problem for 6th graders.

p. C27 Students are told to use concave and convex lenses, but are never told what they are. There should be many diagrams accompanying this topic and yet students are never shown a ray diagram. See p. C36 also.

p. C34 The phrase "sensitized by fuming with vapors of iodine" has to be explained for teachers and students alike.

p. C35 The "families afraid of separation by death" statement is very strange. Did the daguerreotype alleviate this fear?

p. C39 The directions for making a triangular shape out of a soda bottle for a prism are no help at all.

p. C40 Again a diagram of light refracting within a raindrop and a picture of a rainbow and the conditions for a rainbow to be seen would be much better than pure text and a poem about rainbows. In addition, the prism drawing is not quite correct. Writing a poem about rainbows or sound (p. C51) is not very scientific.

p. C47 The teacher notes say that "Blue light will cause all but blue objects to appear black", but the picture of the tomato on the previous page in blue light appears to be blue, not black like the picture beside it.

p. C 48 Students should be given the color "wheels" shown on p. C38 of the teacher's edition. Most of the students probably won't know what the colors cyan and magenta are.

p. C 48 Why isn't the "Food Color Kaleidoscope" done at this point rather than earlier? It would make more sense to do it when talking about pigments.

p. C54 The dolphin echolocation section is very interesting and a nice addition to the sound discussion. It also goes well with the "Medium Matters" activity on the following page. This makes for a very good story line that provides information as well as incorporating some good science activities.

p. C71 starts a new section entitled "Let the Current Flow." It's charges that flow. Letting students know this at an early age could help later on.

p. C73 The water circuit analogy is a good one, but students should be warned that it is an analogy and that charges do not come spewing out of a broken circuit.

p. C78 The excerpt about Tesla is interesting, but why would we want to tell kids that he "insisted on having exactly 18 napkins before him at every dinner ... and would not stay in the same room with a woman wearing pearl earrings"? This seems an especially strange piece to include especially when we look at question 2 on the following page: "Do you think that Tesla's characteristics helped make him a good scientist?" Perhaps relegating such stories (Cavendish was a bit strange as well) to the teacher notes would be better. Students already believe that scientists are strange.

p. C85 The teacher notes encourage a discussion about how Farnsworth (who invented the TV) learned about electricity by taking apart and reassembling a home generator. The TV is one appliance that should NOT be taken apart by children because of the safety risks involved. That point should be stressed.

General Notes About Unit C

Since this is a 6th grade level book it can't be expected to cover everything that one would wish. It's too bad that the other grades are not available as this section makes a good jumping off point for light and radio waves from the stars. The umbrella activity on p. C66 could be modified for these radiations.

Unit D: SeaBase Nautilus

p. D15 The picture/story of the circling barracudas is interesting, but where is the science? Similarly for the story of the girl who dives for pearls (p. D20.) Opportunities are being missed too often.

p. D49 Text states that "plants and animals need fresh water to survive" but the previous text had just discussed animals that live in salt water.

p. D52 There have been a number of good Teaching Resource Sheets. This "Count Off" activity for statistically determining a population count is a good one.

p. D58 The neap tides should occur twice per month (not once as stated in the teacher's notes.)

p. D63 If the students fill the baking pan with water in "A Chilling Experience" and then pour two glasses of water in, the pan will overflow.

p. D68 If there were a lot more activities like this one to demonstrate the volume inside the submersible, Alvin, we would begin to approach a meaningful science book.

p. D72 The "floating iceberg" activity instructs students to have the teacher float a bag of ice (the students are not supposed to know how big the bag is). The teacher's notes imply that the students should do it (but this would ruin the experiment. They would know the result before the observation took place.)

p. D77 78 The two depth measurement labs should have been performed right after the sonar discussion (on p. D29) to have the material ready for the Titanic story. This clearly would be a good example of using the physics principles learned for a problem.

p. D91 Once again we are warned about having "too much confidence in technology". It would be better to explain how important it is for engineers to learn from the *human mistakes* that led to these disasters and to stress the *improvements* in human quality of life that science and technology has brought us.

Section E: Blackout!

p. E16 Teacher's notes say that the flask should get warm during the experiment of mixing baking soda and vinegar, but the students are never told to *touch* the flask.

p. E18 The students are asked only about the environmental effects of *nuclear* energy.

p. E22 The "Teaching Resources Sheet", p. 125, shows an experiment of a toy car coming down a ramp to hit a paperback book. The students are asked to measure how far the book moved. If the book is positioned as shown in the diagram, all it will do is topple over.

p. E27 Teacher's notes suggest students describe a school day without electricity, which has already been asked, on p. E 17. It's still taking away time from science class, just the sort of thing an under-prepared teacher will latch on to and think that science is being taught. In addition, on both p. E30 and p. E24, it is suggested that students look at their home energy bills.

pp. E28-E29 The Follow the Energy Trail schematic diagram is very good, but an opportunity is missed to point out that all "energy stations" perform much the same function – they just use a different fuel and method of "burning." The anti-nuclear and pro-solar biases are clearly evident from this point onward. Even though pointing out some pros and cons they are weighted. Solar energy (including wind) is not free! In fact, it is very dangerous and expensive and does pollute, but the authors never mention these drawbacks.

p. E50 The wind turbine experiment (using two household fans) is another example of solid experimenting that can be done in Middle School, but the authors do not follow through.

p. E52 Photovoltaic cells are described, but no explanation (even a simple one) is offered for how they work.

- p. E56 The explanation of the term "short circuit" in the teacher's notes is not really an explanation; it's just a description of one effect of a short circuit.
- p. E75 The acid rain experiment description does not include an explanation of what the red and blue litmus papers represent in terms of acidic content. A comparison with various other materials including say, tomatoes, on litmus paper would make the experiment meaningful.
- p. E76 The authors finally get around to including the ecological effects of fossil fuels, but the book is still skewed against nuclear energy. The section on fossil fuels shows a few dead trees and damage to the Statue of Liberty (presumably from acid rain). The nuclear energy section (two pages later) states "radioactivity can cause cancer, genetic effects, birth defects, and death". True, but why aren't the horrible effects of fossil fuel use mentioned? (Asthma attacks in children, respiratory illnesses, mining accidents, etc.) On later pages, the book states that "solar thermal conversion stations produce no waste products, so they don't harm the environment," and "photovoltaic cells don't produce pollution", but the *production* of the special materials for thermal conversion stations and of photovoltaic cells *does* produce pollutants and many deaths. There is also no mention of the tremendous areas required for solar plants and their effect on the environment. The authors may be attempting to show pros and cons of these energy sources, but they aren't doing a very good job of being objective.
- p. E84 The Kuwaiti oil fire story is interesting, but nothing was done about connecting the physics principles used to put out the fires and ends with the statement "Now young Kuwaiti scientists have become environmental watchdogs. They have vowed never to let such a disaster happen again." Nice thought, but let's stick to teaching science here.

General Notes about Unit E

The discussion of energy and energy transformation is badly flawed. Too much time is being suggested for topics other than science and not enough time on interpreting basic experiments performed by the students.

Unit F: The Secrets Within Seeds

p. F1e "Cotyledons" is used without a definition, but pops up confusingly on p. F55.

p. F32 Having the students actually design their own experiments is a great idea ("Growing Roots"), but one of the criticisms of this book (and the others that we have reviewed) is that the students have not gotten any experience designing experiments!

p. F69 The text states that seeds germinated in the orbiting space shuttle were "not subject to the force of gravity." These seedlings are in free fall and certainly are subject to the force of gravity.

General Notes about Unit F

This is a section on biology primarily and yet we see that an understanding of physics is still important.

Prentice-Hall Science, Prentice-Hall Science Explorer, Prentice-Hall Exploring Physical Science, Prentice-Hall (Now Pearson) (Many dates and many variations.)

Several years ago my colleague, Donald Holcomb of Cornell University and past president of the American Association of Physics Teachers, knowing of my interest in the science being taught in elementary school, passed on a letter from Howard P. Lyon (HPL) that had questions about the science in his daughter's Middle School text. The book was published by Prentice-Hall. I contacted Mr. Lyon and we have been corresponding ever since. The following notes come out of that correspondence.

If we were to comment only on the merits of the books generally available at the Middle School level, our report would be extremely negative. We have made many side comments that reflect on the publisher's response to criticism. To JLH this has been rather eye opening as previous experience with Prentice-Hall (and many other publishers) at the college/university level has been mostly positive. Publishers at this level seem hungry for reactions to their texts and welcome suggestions for correction and improvement. While it may seem that Prentice-Hall/Pearson has been unduly picked upon, this only reflects a long history of advertising suggesting that they set the standard and have now gone beyond and we do not find that to be the case. Instead we find a poorer product than what was available in the early 1980s from the same company.

In addition we present references to the work of others with similar goals such as The Textbook League (TTL, P.O. Box 51, Sausalito CA 94966) and the American Association of Physics Teachers' Pre-High School Committee.

Middle School students are curious, but not necessarily skeptical. They believe the material in a book is TRUE! A colleague of mine, using a text that he had authored, was challenged by a student when he suggested that perhaps there might be an error in his own book! Slight errors become rooted in students' minds for life, if not strongly corrected. In the sixth grade, I (JLH) read that the helicopter had been invented by Igor Sikorsky and "the U.S. Atmy." I knew that it was a misprint, but I wonder how much was written that was not true. It is very important that we root out errors of all sorts.

PH SCIENCE EXPLORER (2000) shows in each volume (on 4th page of skills handbook in the back) the "weighing" of a 0.1 kg red apple on an "electronic balance". At this level perhaps a scale of a type most likely to be found in a Middle School classroom would be more appropriate.

Reading in the text that an apple has a mass of 0.1 kg our student may go through life believing that that is a typical value for the mass of an apple. Remember that an appreciation and feeling for the SI system of units is important in all science

classes, this should be a realistic value. HPL thought that it wasn't and did a simple experiment (a practice that should be encouraged in all students) to find out. His results using four each of 13 different types of apples indicated that there were no apples that had a mass as small as 0.1 kg. Another reviewer (HHG) in a different state found some apples that were actually less massive. In a third state JLH found some "crab" apples that were less than 0.1 kg. This exercise would be an excellent one for students. They could practice converting from English units to SI, for example. Apples come in 5lb and 10lb bags leading to ideas about "averages" and "most likely." They could make a histogram of all the apples that fell within particular mass groupings that students brought to class. They would also see for themselves that the apple in the text was not a typical apple.

CONCLUSION (HPL): It is contrary to my experience here, and to any student observing these apples, that a red apple should be less than 4 ounces. Even the littler green apples (the bagged Granny Smiths) here are over 4 ounces. Note also that I chose the smallest apples from each bin.

Citing an "apple" outside the bell curve of the varieties at the store (and at half the median range) in explaining the SI misleads the student. It would be like referring to a 28 kg Miss America* (That's under 62 pounds folks!) Clearly, the apple on the scale should be more likely 0.2 kilograms. Miss America, between 1921 and 1970 averaged 123 pounds with 106 the lightest in 1949 and 143 the heaviest in 1943 per Appendix 14, THERE SHE IS, The Life and Times of Miss America, Frank Deford, Viking Press, NY, 1971, SBN 670-69858-x

The same apple resides in FOCUS ON PHYSICAL SCIENCE (P. 827), FOCUS ON LIFE SCIENCE (p. 761) and FOCUS ON EARTH SCIENCE (p. 715) all copyrighted 2001 and voted in by California on January 21st, 2000 (lunar eclipse date -- partial lunar eclipse is wrong in the book as adopted).

We have found lots of errors. The number is overwhelming. What could possibly be wrong with the authors? Don't they know anything about science? This question necessitated our looking into the qualifications of the authors. The

investigation into the background of the "authors" for these books was much more thorough than the other books reviewed. Conclusion: The "authors" for the most part admitted that they did not write the book. A few reviewed and made suggestions, a few contributed essays, and a few did some other types of work.

A September 6, 1999, transcript of 20/20 Book Report (re-run) (call 212 456-2324 to get a copy) has Sam Donaldson say of the authors, "the publisher admitted to us that none of them had written the book." Pearson/Prentice-Hall had ample time after the April 2nd first airing to request a correction if this were not so.

North Carolina's price list of adopted texts following adoptions proceedings in the summer of 1999 lists the author for Exploring Physical Science as "editorial".

Most of the people whose names appear in the title pages of Exploring Physical Science lack credentials in physical science. Prentice-Hall has taken steps that obscure that fact. The title pages i - xiv (i and ii lack page numbers) of Exploring Physical Science 1997 Second Edition, 3rd printing, ISBN 0-13-418716-4 (EPS) do not indicate anywhere that this book is part of a "set" of books. The other members of the "set" are Exploring Life Science and Exploring Earth Science. It is specifically NOT a part of a sequence because the reading and math levels are geared to a "generic" middle school standard. This allows schools to present these courses in any order. Five of the six listed authors had credentials in life or earth sciences and the sixth did not have time to write the book. None of the listed authors should or could have written the book.

Page ii of EPS lists a National Science Consultant named Kathy French. She may be the "contributing writer." Kathy French is listed in Biology 1991 First Edition, 4th printing, ISBN 0-13-081241-2 (BIO) as a Biology Teacher at Hurst-Euless-Bedford Independent School District, Bedford, Texas. A number of editorial people are common among these texts. Except for Ms. Christine Caputo, who wrote that she had a degree in physics, we know of no particular credentials for those people who have broad responsibilities and are also the last who could have caught the spectacular goofs in earlier editions such as the flopped photo of the Statue of Liberty in 1993, 1994, 1995 and 1997, or the picture of Linda Ronstadt

described in 1997 as a silicon crystal doped with an arsenic impurity.

Prentice-Hall knows very well that most of the people listed as “authors” are primarily grounded in biological sciences. PH has published their biological credentials in Biology. Calling them generic "Science Instructors" in Exploring Physical Science leads administrators and teachers to believe that this text has had its contents reviewed by these thirty-six people who are out in the field now in the listed subject. "Thirty-Six Content Reviewers. Wow! I should be safe choosing this book" would be a reasonable response. Of the content reviewers that we were able to reach, only one had a physical science background. He admitted to reviewing nothing since 1992.

Twelve of the EPS Content Reviewers shown as "Science Instructors" are credited as Biology Teachers in other PH texts or personally told us of their biological background. The thirteenth is in math education. In the best case scenario one third of the listed content reviewers could actually have had training in Physical Science.

Listing thirty-six content reviewers in the front of EPS must reassure (and intimidate) students, parents and teachers who are fuzzy on the difference between momentum and kinetic energy, inertia and gravity or even about the metric system. Intimidation may not be the goal, but why list as content reviewers people who did not review the content of the book and why obscure their actual credentials making it appear that they are competent to review the content of this book?

By April 1997 Prentice-Hall Science, 1997, 3rd edition listed in each of the nineteen books the same thirty-six content reviewers plus five more, but by the 7th printing (Fall 1998) these five were no longer listed. How can these five have reviewed it in April 1997 and not be listed as reviewers in October of the next year? It's the same stuff!

One reviewer admitted that he found 25 errors in Chemistry of Matter (the only

volume that he reviewed.)

As of the 2nd printing of EPS, 1999, 3rd edition, teacher version, which is a photographically reduced EPS, 1999, 3rd edition, student version, there are still only the "original" thirty-six content reviewers. One can readily make up a page concordance between Exploring Physical Science and Prentice-Hall Science noting only minor differences.

The page layouts have remained constant throughout. PHS is available in editions of 1993, 1994 and 1997, and EPS in editions of 1995 and 1997. When a new edition comes out there is a new ISBN number. There is no reference in EPS to the pre-existence of PHS. Therefore a purchaser may not determine whether or not a review of PHS is pertinent to an evaluation of EPS.

"Tear sheets" sent to Millcreek in summer 1996 to show tentative fixes were longhand fixes on PHS page copies, and some were on EPS page copies. Changes on student pages were not always accompanied by changes on the teacher pages.

A history of the interaction among a concerned parent, a school district, and the publisher in an attempt to clear up the large number of errors in these books eventually led to the 20/20 show.

One Parent's Experience

(An unpublished letter of HPL describes the frustration of a parent with this publisher.)

My seventh grade daughter brought home the brand new Exploring Physical Science; copyright 1995, in the fall of 1994 and within weeks had found gravity goofed up. Before Christmas we had found eighty some mistakes, and I had spoken to her teacher and her principal and to administrators downtown. With frustrating and agonizing slowness (my opinion then) the administrators set up a faculty committee to review my findings and the text and write corrective measures where appropriate. With excessive courtesy and attention to protocol (again -- my

opinion then) the district contacted the publisher.

With 20/20 hindsight it is obvious that the school district did absolutely everything as perfectly as could have been done. The 34 page booklet of corrective measures has been available to students ever since. The publisher paid for the printing. The school district tried to work with the publisher rather than to just simply get the deal undone. And the saga developed bizarre and Byzantine complexities.

The publisher sent out a group of executives to explore possible remedies on May 8th, 1996. That morning the district received a 2nd edition, 1st printing of Exploring Physical Science -- 1997 copyright. My one-hour pre-meeting examination of the book with a mathematics professor found most errors checked continued intact into that printing. After the meeting the publisher offered a "corrected" 2nd edition 2nd printing as a free pilot for the district. Before printing that, the publisher sent the corrective measures and the text to an outside expert chosen by Publisher's Resource Group for evaluation.

In July 1996 the publisher also gave the district an opportunity to review 118 pages or "tear sheets" of proposed fixes before printing. Most of the fixes seemed reasonable, though some were so garbled as to make no sense, which the district duly noted in its response. The Publisher's Resource Group sent its four pages recommending a few specific fixes along with suggestions for careful editing.

In August 1996 the publisher sent a 2nd edition TEXAS edition 1997 (which has a 32 page Texas supplement just in front of the first title page of the student text) as evidence of progress.

In September 1996 the publisher sent the 2nd printing of the 2nd generic 1997 (non-TEXAS) edition to Millcreek School District. (This is the first time since 1993 that the full-page photograph of the Statue of Liberty was not flopped left to right. Now a photo of Linda Ronstadt has a description calling her a silicon crystal doped with an arsenic impurity. Ronstadt's photo had been involved in one of the garbled tear sheets. Most errors stayed in place and the publisher offered a corrected 3rd printing.)

In November 1996 the publisher sent the 3rd printing to Millcreek. (This is the first time since the 1988 predecessor text Prentice-Hall Physical Science there was no time/temperature graph of freezing water that omitted the heat of fusion plateau in the chapter introducing the scientific method. It is replaced by a time/distance graph and a chart headed "Distance a Train Traveled". The first entries on the chart show the train traveled 2 kilometers in 0 minutes. "How long would it take to travel 4 kilometers?" comes to mind.)

By April of 1997 Simon and Schuster's Director of Science, Julie Levin Alexander, assured Dr. G.

Kip Bollinger, Science Education Adviser for the Pennsylvania Department of Education (who had been part of the good manners and agonizing slowness as he worked with the District and with Prentice-Hall) that all corrections would be made in the 5th printing of the 2nd edition.

By November 1997 the 5th printing was complete and a sample forwarded to the district, and again some fixes had been made and new errors had been made, and most errors noted earlier were still in place.

I have no idea where the errors really came from or why they cannot be removed from the book, but I suspect that the fact that the listed authors did not write it (or are trained in subjects other than physical science) and the fact that most of the 36 listed content reviewers did not review the content (or are trained or employed in subjects other than physical science) may have something to do with it.

Research finds that authors Johnson, LaHart and Wright have PhDs in Education involving Biology. Two of those PhDs are not listed on the title pages of Exploring Physical Science. Author LaHart is the only author with an article in ERIC 1992 - 6/97 and his article is about rabbits. Hopkins has a listing in OCLC database as author of the life science curriculum for her school district. Authors Hopkins, and Maton and Wright told me they did not write the text. Writing a best-selling text should be an occasion of pride, however, Author LaHart, when I spoke with him, would neither confirm nor deny that he wrote any part of the physical science material. Author Warner's school told me in '96 she taught earth science, and in '98 life science. Hopkins and Warner are shown as "Science Instructors" on the title page that does not show which science they instruct. This is curious! Six out of six of the listed authors are either A) trained or employed in fields other than physical science OR B) did not write it OR C) BOTH A and B above.

If I have a personal plumbing problem beyond the scope of a general practitioner, I would consult a urologist rather than a dermatologist. If my child has a rash on her face I would find her a dermatologist rather than a proctologist. Why not use physical science people to write a physical science text?

I have watched 5 "new and improved" versions of Exploring Physical Science come to Millcreek. The book is beginning its fifth year and will confuse and intimidate yet another class.

Page 53 of Exploring Physical Science says, "The density of water increases with depth. So the density of water increases as you go deeper under the surface of the water. So the density of deep water is greater than 1 g/ml. At a certain depth, the SCUBA diver's density is equal to the water's density. The diver will not be able to sink below this depth." This is not a discussion of water temperature and how

water density decreases as the temperature goes up or down from 3.98° C. It is not a discussion of how pressure increases with depth. It is a continuation of a discussion about investigating the warship Mary Rose where she sank off of Portsmouth Harbor, England. Page 39 says, "Some of the divers wore heavy weights on their belts so that they could hover above the sandy ocean bottom."

This misconception could have fatal applications. Prentice-Hall is saying that water's density increases with depth. That is true. Its coefficient of compressibility is usually quoted as $4.51 \times 10^{-6} \text{ atm.}^{-1}$. That means that if you take a liter of water down to about 10 meters where the pressure is twice what it is at the surface the water will no longer take up 1 liter of volume. It will lose 4.51 millionths of its volume. If you take it down 10 kilometers (about 6.25 miles) to where the pressure is 1,000 times higher than at the surface, water will lose 4.51% of its original volume at the surface. Students are led to believe that (beginning from a depth of neutral buoyancy) without adding weight, the diver cannot go deeper because water's density increases with depth. The diver's coefficient of compressibility is higher than that of water because the volume of air in the lungs will halve each time the pressure doubles unless the diver inhales or exhales. Youthful divers risk drowning if they think that denser water under them will prevent them from going too deep. If a budding SCUBA diver adds weight from a depth of neutral buoyancy that diver will go *all the way to the bottom* faster and faster unless the weight is dropped and air is regulated in the buoyancy compensator until the previous position of neutral buoyancy is regained ... **OR THE DIVER MUST ACTIVELY SWIM TO REGAIN** the position of neutral buoyancy. The position of neutral buoyancy is not a stable place because the diver's overall density increases with each exhalation and decreases with each inhalation. There is also what sport divers call the neoprene factor. A wetsuit made of thicker neoprene foam requires the diver to wear more weight than one made of thinner foam.

Try to "park" p. 366's Cartesian Diver at a position of neutral buoyancy to see if the inherent instability of such a place can be fixed by adjusting weights on the diver and without changing external pressure. No one can. It would require the

same accuracy as balancing a needle on its tip on a china saucer. Presumably if the center of gravity of the needle were directly above its tip it could balance, but "pin-point" accuracy is impossible. On p. 366 the medicine dropper Cartesian Diver with air inside it and with an appropriate weight of wire wrapped outside it is a perfect analogy to a real SCUBA Diver.

The rubber "head" of the medicine dropper has air in it. When the sealed outer container holding the liquid and some air and the diver is then squeezed, the rubber head is also squeezed, compressing the air in it a bit so that the overall density of the diver is above that of the surrounding water, so it sinks.

Re: p. 53 of EPS, as of 5/30/99, Prentice-Hall/Pearson Education treats this on their website as a "correction for clarification" and offers new language to point out that the density of water increases as the temperature decreases. (Be careful how you read this from the net because the new language is erroneously under "Original Text" and the old language is erroneously under "Revision"). Yes, indeed the density increases. American Chemical Society reference work shows how much. For instance, if you drop the temperature 1°C from 25°C you will lose .00025705 of the water's volume (that's about 1/40th of one percent). If you drop the temperature 1°C from 20°C you will lose .00020661 of the water's volume. (That's 1/50th of one percent). If you drop the temperature 1°C from 10°C you will lose .00008790 of the water's volume. (That's less than 1/100th of one percent). If you drop the temperature 1°C from 8°C you will lose .00006037 of the water's volume. (That's less than 2/3rds of 1/100th of one percent). A temperature change of 20 degrees Celsius would be extreme (it would equal 36 degrees Fahrenheit -- from 70 degrees F you would go down to 34 degrees F or up to 106 degrees Fahrenheit), and would result in a volume change in the water of quite a bit less than 1/2 of one percent. Obviously, these increments are extremely small when you realize that the weights divers purchase are sold in increments of two pounds. To deal with that 20 degree Celsius increment of temperature change the fully equipped diver would weigh 400 pounds to provide a proportional increment of buoyancy compensation!

The Mary Rose sank in the Solent, at 45 feet. That depth increases the pressure by a factor of more than 2 and less than 3. (You can read about it in the National Geographic of May 1983 among other places.) The temperature differential is somewhat less than 20 degrees. The diver's lungs have a 5-6 liter air capacity. The diver's intestines have an unknown and variable amount of gas. These gases and the bubbles of his neoprene suit will be compressed to less than half of their volume at the surface (basic gas law relationship between pressure and volume). He will therefore displace at least 3 liters less water at 45 feet and that would be equivalent to adding about 3 kilograms of lead to his weight belt. (To avoid an uncontrolled and possibly fatal descent to the bottom if he were in deeper water he must add about 3 liters of air to his Buoyancy Compensation Device)

What does this mean? PH does not know about SCUBA diving or about the density/temperature/pressure relationships of seawater and should not use the one to explain the other. To add insult to injury, it says that the Mary Rose sank because its density exceeded 1 g/mL. All of the seawater in the Solent is ocean water, and it all exceeds 1 g/mL, regardless of depth or temperature because of the dissolved salts.

The person who wrote this page probably miscopied material that said that as you go deeper the pressure of the water increases.

More from p. 53: Even with the proper amount of air in its swim bladder (in part a sensory organ) a fish must swim continuously to maintain a preferred depth/pressure. At death, the fish's body will not find and stay at a position of neutral buoyancy as would be expected with a constantly increasing depth-dependent gradation of densities toward the bottom. See pages 74-76 of *The Life of Fishes*, N.B. Marshall, 1966. A definitive experiment would be to inject a dead fish with the exact amount of air to make it float between the top and the bottom. It won't. See the Cartesian Diver. In other words, fish do NOT "maintain their position in the water by emptying or filling an air bladder in their body." In order to maintain their position the fish has to swim! Experimentally: Goldfish need 5-7 days to fill their swim bladders with air. Freshwater eels need 12 hours. Minnows swim down in response to a decrease in pressure, and up in response to

an increase (Marshall, op. cit.).

It is true on page 64 that liquids "do have a definite volume". Gases expand to fill the space available. Liquids don't. Gases compress under pressure. Liquids don't, at least not very much. The dramatic proof is illustrated by taking a jug, filling it with water as full as possible (no air), corking it, and then hitting the cork one last time, exploding the jug.

Consider the story of Archimedes and King Hieron's "gold" crown p. 52. Notice that with a density/depth relationship noticeable by Middle School students one must show how deep the crown is to be sunk beneath the surface to get a good answer. Obviously when first under the surface of the water the crown will displace its own volume at one gram per milliliter for the density of the water. As it goes down farther and farther it will continue to displace its own volume (let us assume the gold is incompressible) but as the water it displaces is more and more dense then more and more mass of water will be displaced. Not true! It would be of far more value to have students figure out what exactly Archimedes **MIGHT HAVE DONE** to solve the gold crown riddle. **THAT** would be good science!

Prentice-Hall's density disaster "photograph" floats solids of various densities in liquids of various densities. If it is a photograph, the densities are never right. If the densities are ever right it is not a photograph. This has been goofed up since 1986 in multiple series, editions and printings.

EXPLORING PHYSICAL SCIENCE 1995, 1997, 1999 p.54; PH Science, MATTER, BUILDING BLOCK OF THE UNIVERSE 1993, 1994, 1997 p. 26; PH PHYSICAL SCIENCE 1988, 1991, 1993 p. 38; and PH General Science, A VOYAGE OF ADVENTURE 1986, 1989, 1992 p. 322.

When I (HPL) questioned the illustration, editor Caputo wrote me Feb. 3rd, 1995 that they had "performed the experiment" and that "The source of the photograph has been confirmed". On April 3rd, 1995, I sent a challenge by registered mail offering to pay \$1,000 if they could do another photo using the densities as

shown. I know of no response until the third printing of EPS-97 which is "corrected" to show rubber with a density of 1.19 gm/cm^3 SUNK TO THE BOTTOM of glycerine with a density of 1.26 gm/cm^3 . It cannot happen!

Science Explorer (2000), (a new Prentice-Hall product in distribution in 1999) Volume M, page 95 has similar liquids and solids in a container to demonstrate buoyancy and density. In this case the rubber has a density of 1.34 grams per cubic centimeter, and it has sunk into the boundary between the glycerin at 1.26 and the corn syrup at 1.38. Go back and check on the density disaster which has been demonstrably wrong since 1986 in Prentice-Hall publications, is uncorrected on the corrections website, and which is finally (if not covertly) repaired in the 2000 copyrighted material.

The Periodic Table of the Elements is always of interest to check out. In 1953 scientists had synthesized element number 100, named Fermium. Of course, elements have been and are being added. Apparently in an attempt to be "up-to-date" the number has been changing up and down with various printings and editions. Not one was correct at the time of publication. The safest bet is to simply present a table, list confirmed elements and leave appropriate spaces to add new ones.

For example, there are 109 elements in the 1997 Prentice-Hall Exploring Physical Science pp. 142-143, and two elements are listed as liquids: Bromine and Mercury, which is correct. (This is the 2nd printing of the 2nd edition.) The annotated teacher edition asks how many are liquid and says 4!) The 1995 Prentice-Hall Exploring Physical Science pp. 142-143 has 4 liquid elements listed: Bromine, Mercury, Cesium and Gallium. Similarly for the 1998 Prentice-Hall Biology. The 1983 Hubbard Scientific Chart lists 5 liquid elements: Br, Hg, Cs, & Ga plus Francium which melts at a higher temperature than Br or Hg and freezes at a lower temperature than Cs or Ga. The Chart is correct at body temperature. Whether an element is liquid depends on factors such as temperature and pressure. Where liquid elements are identified there is usually a phrase indicating that the identification is made at either Standard Temperature

and Pressure or at "room temperature." Inasmuch as some of the higher numbered elements have been synthesized in numbers of atoms fewer than say 10, it is difficult to say whether they should be listed as solids. Since phase is a characteristic of a large number of atoms, this is an ambiguity, which is avoided by some publishers by not indicating the phase of synthetic elements.

Using the pseudo-Latin temporary names is silly and inappropriate. CXI would have worked for 111. The un un un ium seems silly. The un un bi um is nearly equally so. The un nil sept ium was laughable as Roman Numerals are not a decimal system and here the nil is obviously a naught in the 10s place. What does this teach?

Another practice is that some publishers indicate which elements occur naturally and which are necessarily synthesized. The line is blurred sometimes with careless language (Sentences like, "Seaborg found Plutonium in Uranium." Did Seaborg synthesize plutonium from uranium, or did he find plutonium in uranium ore?) My Britannica does this well, and shows plutonium existing naturally, though greater amounts are more easily found as a by-product of fission reactions. Now then, the publisher indicating elements occurring naturally or as synthesized has a problem. How does one handle these? Some use a code placing a whole number atomic weight in parentheses indicating that this is the longest-lived isotope of a synthetic element. An atomic weight, usually to three decimal places, and with no parentheses codes the element, as naturally occurring and the average atomic weight of the various naturally occurring isotopes is the atomic weight listed.

The best chart might be free. Volkswagen's 1999 beetle campaign puts out a periodic table with the VW in the place for atomic #150 - Turbonium. That's fanciful, but the rest of the table is far more accurate than most.

PH Facets on...series, 2001, which California just adopted, lists 112 elements, and the body of the text says "about a hundred elements".

Science Links has a paragraph referring to 108 and a different number on the

periodic chart.

Most texts present the Periodic Table as carved in stone. Placing dates on the Table would solve the problem and let the reader know that it is still in flux as is all science. Better yet, a reference to a web site that belongs to the Department of Chemistry, University of Liverpool, with links to IUPAC and to the Royal Society of Chemistry. The address is case sensitive and is:

<http://www.liv.ac.uk/Chemistry/Links/links.html>

Integrated Science from Carolina Academic Press has Book One on page 111 and Book Two on pages 54-55 include periodic tables of the elements. The 1990 book lists 107 elements and pledges allegiance to IUPAC in referring to elements 104 through 107. 1990 on p. 51 has an alternative table showing 103 elements. Enigmatically hydrogen is discussed as an alkali metal on page 46 and as a non-metal on p. 48. Perhaps that's because each periodic table in the 1990 book lists hydrogen twice ... once on the top-most left and again next to the farthest right (adjacent to helium) again on the top row. The 1995 book (presumably more up-to-date) lists 106 elements, and also uses the IUPAC names for elements 104 through 106. Fortunately, the doubled hydrogen is gone.

Interactions and Limits, 2000, ISBN 0-89089-778-6 lists 112 elements on periodic table on pages 186-187. There is a note that says, "Element names conform to the current usage of the International Union of Pure and Applied Chemistry at the date of publication." Page 181 says, "Scientists are now experimenting to create ... a new element 114." From this evidence it becomes apparent that this material was written before element 114 was synthesized in January 1999. Inasmuch as elements 118 and 116 were synthesized later in 1999, none of this material will ever be true in 2000. Many science text publishers have been caught by their own copyright inflation.

Where do all these errors come from? There are publishers who would have you believe that we will have errors with us always. Some errors may be unavoidable it is true, but, many textbook errors suggest that the producers of Middle School

science texts are cutting corners.

Typically the title pages list several people in the position of "authors", "project directors", "program authors", etc. Buyers are led to conclude these people were active in the production of the book. Their credentials or affiliations are listed in such a way to indicate they were trained in the subject matter.

Listed editors are presumably experienced with the subject at hand and have basic general knowledge. Illustrators, artists, photo editors and image bank librarians may not perhaps have specific knowledge of the subject, but, presumably have expert status in finding or creating appropriate images, and presumably have adequate supervision by knowledgeable editors or authors to ascertain the accuracy of the science involved.

Several dozen people will be listed as "content reviewers", "classroom reviewers", "field evaluators", etc. Their credentials or affiliations allow the buyer to think they were qualified to have an active role in the review of the material. The buyer is led to conclude the whole book was carefully checked.

With errors such as: listing the points of the directional compass (clockwise) as North, West, South and East (Prentice-Hall, 2000, and 2001); placing the equator around the globe on Tijuana, Tucson, Texas and Tallahassee (South Western Publishing, 2000); having a prism bend light the wrong way (Prentice-Hall, 1993, 1994, 1995, 1997, 2000; South Western Publishing, 2000); having a periodic table showing 112 elements in books copyrighted in 2000 and 2001 (elements 114, 118 and 116 were synthesized in the first half of 1999); categorizing infrasound frequencies as those around 400 Hz (South-Western Publishing, 2000); having the Statue of Liberty pictured with her left arm raised (Prentice-Hall, '93, '94, '95, '97; Holt, '97); and Linda Ronstadt described as a silicon crystal doped with an arsenic impurity (Prentice-Hall, '97), you are forced to conclude that the trained author, the experienced editor (and illustrator), and the qualified reviewer were ALL either absent in the development of the fact or concept in question, or (for inestimable reasons) were unable to do their job properly that day.

In high school, perhaps 95% is equivalent to an A. In the professional world let's define 99% professional. School bus drivers stop for the red light at least 99% of the time. Mechanics get the brake job right at least 99% of the time. The surgeon cuts appropriately at least 99% of the time.

The chance of an error getting into print past the team outlined above and listed in the title pages of most Middle School science books should be extremely small. If the author has a lapse, it is to be hoped the editor will catch it. If the editor does not, it is to be hoped the content reviewer will catch it. Realize how many errors there are in the text. (Millcreek PA school district wrote 34 pages of corrective measures on the errors found by a professional musician who had been away from physics and mathematics for most of his life in Exploring Physical Science, 1995, Prentice-Hall. In the same book's constituent units (published separately by PH in '93, '94 and '97, reviewed separately by "The Textbook Letter") it is clear there are hundreds of errors. Prentice-Hall's initial response in print to charges of hundreds of errors was that 5 or 6 errors in a book of this scope is par for the course. The spin-doctor who provided that pie in the sky number was Andrew Giangola. A later spin-doctor, Ms. Nancy Taylor, said for the Baltimore Sun that the errors had been removed. A later spin-doctor is Wendy Spiegel who also has the responsibility of administering Prentice-Hall's Open Book Publishing that allegedly corrects on line what is wrong in the book. It is indeed amazing how many errors remained in Exploring Physical Science 1999 edition and were not fixed in the new Science Explorer series of 2000. The 15 constituent members of this series are reassembled to make the 2001 series just voted in by California in January 2000. "Spiegel" means, "mirror" in German. Concave and Convex mirrors are goofed up in PH 1988, 1993, 1994, 1995, 1997 and 1999, (focal point is confused with center of curvature in every case, so that the angle of incidence does NOT equal the angle of reflection - basic optics). These mirrors are fixed in 2000 and 2001, but not on the website.

Realize that often the "authors" listed on the title pages did not write the book. ABC's 20/20 broadcast on the Prentice-Hall text showed that none of the listed authors wrote anything in the book. Sam Donaldson interviewed Anthea Maton

whom PH had identified as the head author and she told him she'd never seen the book until he showed it to her. North Carolina lists the PH authors as "editorial" in their 1999 adoptions price list. This is a small early step toward honesty.

Realize that the editorial/illustrational staff and the content-reviewing staff are not necessarily trained in the subject. About ten of the listed content reviewers in Exploring Physical Science were biology teachers in Biology, but became "science instructors" in the title pages of EPS. (1995, 1997, and 1999).

Unfortunately, most State and School District committees are not aware that the publisher(s) may take the short cut of not using real experts to prepare the book. They look for curriculum fit, for gender equity, for racial balance, and assume the content matter itself will be accurate. That assumption gets our children and us into trouble.

States and School Districts should not have to provide quality control measures for private enterprise publishers whose own procedure is so poor. However, only those prospective buyers who now check the content have a chance of avoiding the really dumb errors.

What can we do? Errata sheets, web sites, replacement texts, and cash back are all remedies. It is preposterous that a publisher should reverse a full-page photo of the Statue of Liberty for five years with impunity (PH, 1993, 1994, 1995 and 1997), or spell "piezoelectric" incorrectly five times on the same page (PH, 1999).

Prentice-Hall, in Exploring Physical Science 1995 and 1997, on page 308 and in Motion, Forces and Energy, 1993, 1994, and 1997, on p. 20, in word-for-word explications of velocity vectors makes the suggestion that students read The Adventures of Tom Sawyer to learn more about rafting and "the motion of the Mississippi River." If students are to learn about rafting on the Mississippi River, it would appear that The Adventures of Huckleberry Finn would be the better choice to recommend. Tom rafts only a little more than 5 miles total in the two books and Huck about two hundred times as far.

Prentice-Hall advertises its responsiveness to suggestions and criticism. This material was criticized in print in "The Textbook Letter" of Jan-Feb 1993. The responsiveness is not evident. It was not fixed in the 1999 edition or on web page.

The Scientific Method is introduced in '95 beginning on p. 11. The same material begins on 18 A in 1994's Nature of Science. It's similar set-up as in '88 PHYSICAL SCIENCE except that in '88, '91 and '93 instead of salt water the experiment is set up with antifreeze and water. P. 14 & 15 of '95 are spectacular in presenting science fiction. A beaker of water was induced to freeze instantaneously in a laboratory refrigeration unit at exactly minute 25. A beaker of salt water was induced to freeze at 30 minutes. The results are graphed with the temperatures on the vertical axis. The higher temperatures are listed toward the bottom of the page, and go lower in temperature toward the top of the page. Ignored are the heat of fusion plateau, the heat transfer curve, and the difference in specific heat between fresh water and salt water. The Scientific Method introduction continues that after the results are written up other scientists will do the experiment and will duplicate your results. It won't happen. Kids' eyes will glaze over and they'll wonder if Prentice-Hall used special "scientific water". In addition, the text tells students to make "Each interval of temperature equal to every other interval of temperature" as it is graphed. Prentice-Hall prints the graph with some intervals of 5 degrees Celsius and the last interval of 10 degrees Celsius. This allows a continuous straight line at the same slope when the fresh water becomes ice (which has a specific heat half that of liquid water). The same straight line is reflected on the salt-water graph that is flat out wrong there.

Prentice-Hall defended the graph in a letter dated December 29th, 1994, and signed by Christine A. Caputo. She says they "oversimplified a complex concept in order to introduce the Scientific Method". She says this was "not an error but a decision". She says the "graph was not intended to show true slopes and values, but rather to give students who have never explored a scientific question an example of how to do so." She points out that students are "never asked to perform the experiment and reproduce the results." We do not contest that, but

any student who has ever tried to pull an ice cube tray out of the refrigerator 25 minutes after it went in will have to wonder if science has anything to do with fact.

In the 1988 Physical Science this material is graphed on page 13, and involves water compared to a water/antifreeze mixture. The vertical axis is not inverted here as in the nineteen books in '93-'94 or in '95. Here the higher temperatures are higher on the vertical axis and lower toward the bottom of the page. What is special to the 1991 Teacher's Edition is that the freezing point of water is not shown, although a footnote says it is indicated by an asterisk. There is no asterisk and there is no heat of fusion plateau.

Page 21, EPS - 1995 illustrates a cubic centimeter...so too does page 49...describing how to compute volume. A natural sequence of things would suggest a discussion of length, then area, and volume last, each topic once, revisited as necessary.

Page 22 in '95 says, "The basic unit of mass in the metric system is the kilogram (kg)." Linguistically and historically, the un-prefixed "gram" is the basic unit. We know very well that there is an "official" kilogram in Washington, D.C. The students need to know WHY the kilogram has become the basic unit of mass or they'll see science as capricious and beyond understanding.

The teacher's edition for 1991 Physical Science on page 15 in the wrap-around says that metric mass is measured using units called grams and kilograms. "...other units of metric measure...are derived from the base units." There is no discussion of "mks" (meter, kilogram, second) or SI as a system. Isaac Newton did not discover the force of gravity. He invented a theory to explain the observation.

P. 25 in EPS 1995 asks students to convert data from experiments into the same units. Representative values include 20 kg, 700 gm, 0.004 kg and 300 mg. There are several orders of magnitude here. Why not pick some real life data?

P. 26, EPS 1995 shows a metric ruler in Figure 1-20 and says, "Keep in mind that this ruler is not drawn to scale. You cannot use it to make calculations." In fact, on checking it IS drawn to scale.

P. 28 EPS 95 says when using paper on a balance pan "The mass of the filter paper must first be determined." The usual practice is to use the zero adjustment of the balance scale after putting on the paper.

P. 28 says, "A rectangular solid is often called a regular solid." It may be, but incorrectly.

P. 29 suggests students use metric units to make measurement of automobile "speed limit on your street". Speed limits are legislated or set by appropriate bodies. Speeds may be measured.

P. 32 in EPS '95 is same as p. 32A in EPS '94 and p. 26 of Prentice-Hall Physical Science of '88, '91 and '93. It appears that the left hand photo is swapped left to right and the right hand photo really has two left-handed students.

P. 33 EPS '95 under Eye and Face Safety has improved Prentice-Hall Physical Science by suggesting under #1 that when students see the "Eye" symbol they must take precautions to protect their eyes by wearing safety goggles. Prentice-Hall Physical Science of '88 says that too but also includes #3, which says "Always wear safety goggles when you see this symbol," (showing the "Eye" symbol). On the other hand, EPS of '95 has three recommendations for working with live animals, and '88 does not. Neither text uses live animals for anything.

P. 37 asks students to devise an experiment to distinguish between pure gold and "fool's" gold and suggests that they use the concept of density in the experiment. Eventually the texts all (p. 35 in PH Physical Science, '88, '91 & '93, p. A61 in The Nature of Science, '93 & '94) suggest trying to float the sample in mercury, suggesting the pyrite will float and the gold will sink. A more useful way (and one that won't get the safety people after you) to determine which is which:

malleability, streak tests, try to ignite a sample (gold won't burn, pyrite has strong distinctive stench that gold does not) etc. etc. etc.

P. 43 EPS - 95, figure 2-4 shows a scientist doing a demonstration of inertia. He has a dinner set on a table that is connected to a mechanism that can pull the tablecloth out from under the meal. Photographs are both flopped L/R and you can tell it easily because his lab coat emblem is on his right front pocket, his buttons are backward, he really parts his hair on the other side, and he usually holds his knife in his right hand, and uses the conventional table setting. Photos are flopped L/R also in Voyage of Adventure on page 316 in '92, '89, & '86. On page 36, it is NOT flopped in Prentice-Hall Physical Science of '88, '91 & '93.

P. 43 presents the concept of the relationship of mass and inertia, which are, of course, related. The section confuses inertia with gravity.

Page 35 of Prentice-Hall Physical Science '88, '91 and '93 does this differently, but still incorrectly. The text defines mass as a "measure of the inertia of an object".

Page 44 has photo of a bobsled which "can reach high speeds. However to overcome its inertia and to get the bobsled moving requires the strength of four strong people." Yes, to ACCELERATE the sled to competitive speeds requires the full effort of four strong people. Without too much initial static friction (runners frozen in place) one person can start the sled and get it moving. The acceleration is the key word here, and PH fails to use it.

Page 46 of EPS '95 under Figure 2-7 asks, "Why would a person weigh more in a mine than on a mountaintop?" This error is not quickly evident to some people. As Ms. Jill Wright said in her letter to of December 9th, 1994, it is not necessarily incorrect, "However, it is not always the case." She is of the opinion that "a good teacher would present this statement and encourage students to explain why it was true. Then present the reverse and get students to explain how and when this could also be true." In reality you weigh less and less as you go farther and farther up the mountain. You also weigh less and less as you go deeper into the mine. (Gravity is a mutual attraction between masses. As you go beneath the

surface of the Earth the material above you is pulling you up. This is the premise of Jules Verne's *Journey to the Center of the Earth* (where you'd be "weightless"...because the northern hemisphere would pull you north and the southern hemisphere would pull you south.) Airy and Bouguer did the experiments in mines and on mountains, and their results are written up in the *Britannica*.

Ms. Christine Caputo, Science Project Editor, told us we wouldn't need to check with the works of Jules Verne. (Remember this preceding sentence...no need to check with Jules Verne) She agreed there had been an error made. She said that they wanted to get across the concept that gravitational pull exerted by the Earth decreases as distance increases. She said that, "in an attempt to employ a more creative and less conventional example, an error was introduced." She then went into an accurate discussion of gravity, leaving the impression that this was a rare occurrence.

Prentice-Hall Physical Science, '93, '91, & '88 on page 37 asks the student "How would an object's weight at the bottom of a deep mine compare with its weight on the Earth's surface?" The answer in the teacher's edition is "Weight would be greater."

Page 47 in EPS - '95 has in Figure 2-9 an illustration "from a book written by the great French writer Jules Verne" and a photo of an astronaut "floating untethered high above the Earth's surface." Page 817 ascribes the Verne illustration to the Bettman Archive, and the astronaut to NASA. The chickens are flying from right to left.

The Verne illustration actually has the chickens flying from left to right and is titled "A GROUP A LA JARDIN MABILLE" in "ALL AROUND THE MOON" opposite page 144 in a copy of *ALL AROUND THE MOON*, from the French of Jules Verne, under the Edward Roth translation. Why should Prentice-Hall reverse left to right on this illustration? It is not the Bettman Archive making the left/right swap because Prentice-Hall has it presented correctly in the *Voyage of*

Adventure, '92, '89, & '86 on p. 317. The artwork is by Emile Antoine Bayard 1837-1891, and his name is at the bottom of the illustration as is the printer's name, Hildebrand, Paris.

Page 53 of EPS says, "The density of water increases with depth." Yes, the density of water does increase very slightly with depth. I.e. about 4.51 times 10 to the negative 5th power per atmosphere. You'll lose 1/200,000 of your volume for every 30 feet you go down.

P. 54 Density Disaster suggests students look closely "at the accompanying photograph." This is the same illustration as in the Nineteen. It's also in Prentice-Hall Physical Science of '93, '91 and '88 on p. 38. It's also in Prentice-Hall General Science A Voyage of Adventure, '86, '89, & '92 on p. 322. It is NOT a photo, plastic and rubber of these densities float at different places in liquids of these densities. The beaker graduations don't work from any perspective. The optical characteristics of the liquids are not drawn correctly. Ms. Caputo wrote me Feb. 3rd, '95 that they did the experiment, and that "The source of the photograph has been confirmed" in response to my comment. I did the experiment. I did the Algebra. I took some photographs too. Twice I sent supporting documentation to Prentice-Hall in response to Ms. Caputo's letter. Then I bet Prentice-Hall a thousand dollars they cannot duplicate it and I sent the challenge by registered mail. They haven't taken me up on it.

P. 59, EPS '95 more gold/pyrite foolishness.

Page 56 EPS shows an attractive girl ready to do a good experiment about inertia. Why does she get turned around left to right in Voyage of Adventure on page 324, '92, '89 & '86?

The most serious issue is what is and what is not. Scientists must deal with what is there whether or not they understand it. If they don't understand it they are not allowed to fudge the data to make it fit any scheme of any type. Creativity comes into play in choosing hypotheses to explain the phenomena, and experiments to test the hypotheses.

Specific factual errors introduced by Prentice-Hall in these first two chapters include Heat of Fusion Plateau, Heat Transfer Curves, and Specific Heat of Fresh Water versus Specific Heat of Salt Water. Several illustrations are swapped left/right. Does this make any difference? The illustrations represent observations...not decorations. If the photograph is swapped left to right then the observations have not been properly reported. The "photograph" of the floating objects and liquids is proven to not be a photograph. Buoyancy, specific density, refraction in liquids, rules of perspective and, not least, what is truth, are proven to be misunderstood by Prentice-Hall.

Concepts relating to gravity, inertia and acceleration have been demonstrably messed up. Just because Jupiter is 2.5 times the mass of the Earth does not mean that your weight would be 2.5 times more massive on Jupiter. Acceleration is the rate of change of velocity with respect to time. The units are properly m/s^2 and not $m/sec/sec$.

The Jules Verne illustration is intended to show results after a breakfast, which included French wine. The passengers become very merry, the tunes of the Marseillaise and Yankee Doodle are sung very loudly, everyone dances, the dog is excited and the chickens are awakened. As drawn here, everyone's feet are off of the floor. {Le Jardin Mabille was a Parisian Dance Hall (like Le Moulin Rouge, Le Folies Bergere) where Verne learned the polka.} Everyone collapses unconscious. Part of the stupor was caused by a defect in the oxygen production equipment that was later fixed.

In some editions of the Verne book the illustration is used to illustrate the moment of absolute weightlessness, which Verne supposed the passengers, would experience at a certain point in the journey when the pull of the Moon would exactly match the pull of the Earth. As they approached that point he thought they would weigh less and less until zero gravitational pull happened. As narrated here the spacecraft turns over and falls heavy end toward the Moon. The heavy end first orientation would happen by itself only with an atmosphere to make it

happen. Without an atmosphere to decelerate the craft's outside, the passengers would have been weightless in the spacecraft from the moment their gunpowder fuel was through accelerating them. This is known as The Verne Fallacy. A purist might recommend that Verne should be represented by one of his imaginings that had mathematical or scientific interest and accuracy. Check out his computation of the velocity needed to leave an Earth orbit to land on the Moon.

Pages 60-61 of EPS 1995 begin with a full-page photo of ice-encased oranges. This is the start of chapter 3. Wraparound on pages 32-33 of Teachers edition of PH Physical Science asks teachers to direct students' attention to "the photograph of frozen oranges." The whole point of these pages is that the oranges are NOT frozen. EPS 1995 avoids that. A Voyage of Adventure also avoids it, but does have the same general material. Another interesting thing is that in 1995 Prentice-Hall re-writes the page a wee bit and omits the commentary about the freeze threatening "unusual Florida weather". A Voyage of Adventure (pages 328-329) says, "Only a few people working in the orange grove could remember a day as cold in that area of Florida." Prentice-Hall is probably trying to sell the book to Californians. At least two of Ms. Caputo's letters came in envelopes canceled in Jacksonville, Florida.

P. 66, Figure 3-8 is an improvement over Fig 2-11 in '88, p. 44. Improvements can be made.

P. 69 Fig 3-12 photo of an ice cube is swapped L/R if compared with PH Physical Science Fig 2-14 on P. 47 or with Voyage of Adventure on p. 337.

P. 71 Fig 3-15 of the "ice-bomb" is swapped L/R with Fig 14-13 of A Voyage of Adventure, p. 339, and Fig 2-16 of PH Physical Science 1988, p. 48.

Prentice-Hall Physical Science of 1988 has a photo on the cover showing the pattern of concentric circles formed when an object is dropped into a pool of water. The small drop above the pool is actually a drop of water that was forced upward following impact. The '91 edition is substantially the same on the inside,

same material, same pagination. Except for the missing asterisk for freezing fresh water on p. 13, which happens only in '91, the errors remain from the '88 version. The cover shows what is described as a "magnetic disc levitating over a superconducting material". These books are so entirely similar that the Cranberry district, for instance, uses '88 and '91 at the same time in the same classroom. They bought more books when faced with more students.

Prentice-Hall Physical Science of 1993 is also the same. There are no real additional distinguishing features from 1991 except that the cover has the words "NEW EDITION" above the magnetic disc.

Exploring Physical Science of 1995 has a blurb in the Teacher's Edition, Prentice-Hall Science. There is a picture of the '93 with the "NEW EDITION" tag. "With this book Prentice-Hall set an entirely new standard for physical science education. It quickly became the most popular text in its category." Farther down on the same page it says in letters $\frac{3}{8}$'s inches high, "Now, we're setting the standard once again."

Exploring Physical Science of 1995 has most of the same errors as the pertinent nineteen books. It has perhaps 75% of the same errors as Prentice-Hall Physical Science of '88, '91 and '93. The Prentice-Hall General Science series . . . A Voyage of Adventure, A Voyage of Discovery, and A Voyage of Exploration, copyrighted in 1992, 1989 & 1986 have about 60% of the errors, and in general, seems targeted at a slightly less prepared student.

Prentice-Hall Physical Science of 1984 and 1981 is refreshing with far fewer errors, although the water phase change graph gets the wrong slope for steam on p. 353, and curved mirrors are drawn without correct focal points. This is a substantially different book, and the product of what must have been a more competent group of writers and a more capable editorial staff.

Exploring Physical Science of 1977 is a product of Allyn and Bacon, Inc. and is another refreshing and competent text in which we found few errors of

significance.

P. 74 EPS 1995 has a phase-change diagram to show the heat energy-temperature relationships, as an ice cube becomes steam. The slope of the diagram is the same in each phase...solid, liquid & gas. There should be one slope for water as a liquid and another twice as steep for water as a solid and for water as a gas to represent the differing specific heats that water has in these phases. The freezing-melting and condensing-boiling plateaus bear some relationship to what they should be as the former is shorter than the latter. This is the second time ice to water has been shown in the book. This time at least the higher temperatures are toward the top of the page regardless of the other problems.

P. 75 Figure 3-18 has two illustrations. At the top of the page we allegedly "see dry ice becoming gaseous carbon dioxide." We don't. We see water vapor condensing or even freezing as the dry ice becomes gaseous...that's the fog, and on the surface of the solid we see condensed and frozen water vapor. Miss Caputo wrote on February 3rd, 1995, that she understands "that one can only observe this process thanks to the presence of water vapor. Otherwise, the sublimation process would not be observable." This should be re-written to reflect that what is seen in the picture is "what is seen when dry ice becomes gaseous carbon dioxide."

The second illustration on this page shows iodine crystals becoming gaseous iodine. This photo has been swapped L/R from its appearance as figure 2-19, p. 50, 1988, 1991, & 1993.

Page 75-76 make the transition from studying physical characteristics to learning of chemical characteristics by asking students to suppose that they "have to distinguish between two gases: oxygen and hydrogen. Both are colorless, odorless and tasteless. Since they are gases, they have no definite shape or volume. And although each has a specific density, you cannot determine that density by dropping the gases into water to see what happens. In this particular case, physical properties are not very helpful in identifying the gases." Physical properties can be DEFINITIVE in making the identification. Inflate identical

balloons to identical dimensions. See which one floats. Blow bubbles with the gases and see which bubbles float. If you want to find another way other than using physical characteristics then do the chemical tests. Don't tell students "physical properties are not very helpful in identifying the gases".

P. 82 indicates that color, odor, and density are all physical characteristics (see teacher's manual). Molecules react with various nerves and chemicals in nose, tongue and throat to make it possible for people to identify sour acids, delicious chocolate, and so on. Ms. Caputo in a December 29th, 1994, letter points out that that's true at higher levels in chemistry, but that this is "pedagogically appropriate for students." On this one she may be correct.

P. 83 asks students to explain why it is good advice to check your tire pressure after the car has been moving for a while. My tire manual, car manual, gas station and my brother who taught driver training all agree that pressures should be checked "cold". If tire pressure is restored to the "correct" figure after the tire is warm then the tire will be softer than it should be, the sidewalls will flex more than they should and internal friction will increase and tires will get warmer - an unstable and dangerous condition. The "correct" figure is computed by the tire manufacturer for "cold" checking. A few manufacturers have double tables to include "warm" checking but that is rare. Ms. Wright suggested that the teacher ask the parallel question - Why is it poor advice to check your tires warm?

P. 84 and 85 begin the section on Mixtures, Elements and Compounds with an illustration of Sherlock Holmes. Same illustration and write-up occurs in A Voyage of Adventure on pages 366-367.

P. 86 has a photo of yarn which occurs in '88, '91, & '93 PH Physical Science. Trimmed differently here however, and swapped L/R.

Pages 92 - 94 discuss solutions and what their characteristics are. A solution is defined as "a type of homogeneous mixture formed when one substance dissolves in another." As word stems of solution and dissolve are technically the same

word more work needs to be done on this. Examples given include lemonade (made from lemon juice and sugar added to water), blood (illustrated with solid red blood cells going single file through a capillary), and "soot in air."

P. 97 miner photo is swapped L/R compared with Voyage of Adventure on page 378. Last paragraph says for many years scientists had to spell out the full names of elements when writing about them. Then in 1813, a system of representing the elements with symbols was introduced. Prior to 1813, for instance in the 1770's when my facsimile first Britannica was published, there were four elements: earth, water, fire, and air. (Volume II, page 66.) Dalton had symbols circa 1803.

P. 100 figure 4-18 is almost the same as Fig 3-13, p. 73, '88 PH Physical Science, except center picture is swapped L/R.

P. 101 says, "Most compounds are made up of molecules." I (HPL) asked Ms. Caputo about this (and about p. 107 which says the same). She wrote Feb. 3rd that I was perhaps unaware that "ionic compounds are made up of formula units" and "not made up of molecules". Britannica says ionic compounds are different, and that some scientists say crystals are very large molecules, and others say the ions aren't exactly connected. But Prentice-Hall Physical Science, 1984 & 1981 page 184 says, "Salts are a common class of compounds whose molecules consist of a metal ion and a nonmetal ion."

P. 107 says, "The amount of a solute that can completely dissolve in a given solvent at a specific temperature is called its solubility." One should know the amount of the given solvent.

P. 112, Figure 5-1 is to support material concerning indirect evidence. There are Before-After pictures showing a house with full garbage cans, mailbox flag up, and bottles (milk) on the porch. Later the garbage cans are empty, the mailbox flag is down, and the bottles are gone. The shadows in the illustrations are drawn at random. A few pages later, on p. 119, it points out that computer programs can show the effects of light and shadow. Ms. Caputo answered December 29th, 1994, that the illustration is clear and accurate, and that the length of time elapsed

is not an issue nor is the artistic representation of the Sun's shadow. This same illustration (almost) is Figure 4-1 on p. 90 of PH Physical Science of 1988. How old it actually is one cannot guess. How many children in the 1990's are familiar with (milk) bottles on the porch? How many of their PARENTS remember them? How many Contributing Writers? How many Editors admit to ever seeing (milk) bottles on the porch?

P. 113 dates Democritus at "more than 2000 years ago." It says it "took almost 2100 years before an atomic model of matter was accepted" (presumably meaning Dalton - 1803 who is described in the text) and p. 131 dates Democritus at more than 2400 years ago. See page 131 also. Why not use B.C.? On Feb. 3rd, 1995, Ms. Caputo conceded that there was an inconsistency in the Study Guide at the end of the chapter. Reviewers had brought it to their attention, and she said that it had been submitted for reprint "several months ago".

P. 114 has a picture of the Rosetta Stone. Imagine the value of that wonderful artifact if each surface actually told a different story? Think about it. How useful is a book in which the written word is not substantiated by the illustrations?

P. 118, Fig 5-11 is Fig 4-9, p. 97, 1988. It is Fig 15-6 in A Voyage of Adventure. A special feature for 1995 is that it has been rotated one hundred eighty degrees.

Page 124 asks students to imagine locating a friend on a sunny Saturday afternoon, and suggests that they estimate the chance of finding the friend in various places based on past experience. They are asked to list at least seven possible or most likely places, and express those possibilities in percentages. They are cautioned that the "total probability for the seven events should equal 100 percent". The seven most likely probabilities cannot add up to 100 percent. It is possible that the friend could have been hit by a bus and consequently hospitalized, or kidnapped, or ...?

P. 125, Fig 5-17 is slightly redrawn from Fig 4-16 in 1988. It's a silly diagram with too many errors to try and correct. The Activity Calculating on this page

puts out busy work to familiarize students with the Periodic Table. It's called Atomic Math on p. 101 in '88.

P. 126, Fig 5-18 lists mass of the proton as 1 amu, neutron as 1 amu, and electron as $1/1836$ amu. P. 273 shows that in beta decay a neutron breaks down into a proton plus an electron and in addition releases energy. With these figures Prentice-Hall has created both mass and energy. Ms. Caputo on December 29th, 1994, says that actual mass of Proton is 1.00728 amu, and neutron is 1.00866 amu and does not give a mass to the electron. She shortens off both to 3 significant digits "as customary" and comes up with 1.00. If she'll be discussing electrons of $1/1836$ or 0.0005446 amu then the customary significant digits will extend to the same orders of magnitude. Rounding off to same 3 significant digits her electron would have to be 0.00 amu.

P. 133 Critical Thinking says Einsteinium has an atomic mass of 252. "Einsteinium is a synthetic element." The student edition asks, "How does this fact explain why the atomic mass of Einsteinium is a whole number?" I wonder if the answer will be consistent with Ms. Caputo's letter of 2-3-95 or the Periodic Chart as printed.

P. 139 Fig 6-5 has a photo of H.G.J. Moseley. It shows up as Fig 5-6 on p. 115 of 1988 Prentice-Hall Physical Science. 1988 includes his middle name of "Gwyn-Jeffries" and mentions the name of the "famous battle" (Gallipoli).

P. 142 & 143 (and also pages 792 & 793) present a periodic chart of the elements that lists Cesium and Gallium as liquids (and Francium as a solid). There is no temperature where this works. Cesium melts at 28.6° C per Prentice-Hall EPS p. 151, and Gallium at 29.78° C per my Britannica, and Francium at 27° C per p. 151. Rubidium melts at 39° C and one could survive a fever of that level. This is higher than STP and normal room temperature. The error persists later in the text. Ms. Caputo acknowledged this error in her letter of February 3rd, 1995 and says that the correction has been "submitted for reprint". Further, she defends omitting STP from EPS because it would "simply be another fact for students to memorize". I would recommend that writers at PH memorize STP as it applies to common

states of matter.

EPS 1995 teacher's edition wraparound talks about the Latin derivations of elements 104 - 109 and asks students to compare other words with similar stems...including hexagons; however, by '95 Unnilhexium has become Seaborgium.

P. 147 the men in the photo in Fig 6-12 are swapped L/R. Look at the buttons of the standing man.

P. 158 discusses the rare-earth elements and identifies the second row as the elements of the actinoid (sic) series. ("Actinoid" (sic) and "Lanthanoid" (sic) are used consistently throughout for "actinide" and "lanthanide.") It says, (as does Prentice-Hall PHYSICAL SCIENCE on p. 147), "With the exception of the first three elements, all the actinoids (sic) are synthetic, or made in the laboratory." We MINE uranium! Ms. Caputo in her Feb 3, 1995 letter says that the sentence referred to is "simply to point out to students that, with the exception of the first three elements in the actinoid (sic) series, all of the others can be produced in the laboratory. It does not state that these elements do not exist in nature." "Can be produced" is not how these books work. Wraparound of Periodic Table of Discovery teacher edition is clear; there are 92 natural elements, and 17 more have been produced synthetically. Total 109. This is the same in PH Physical Science in wraparound on table of elements. Either/or is how it is for PH and it should be as Ms. Caputo says, that Uranium CAN BE produced in the laboratory, and Uranium exists abundantly in nature. She is emphatic however that "The sentence is correct." and PH "will consider editing the sentence so that others will not have" our confusion.

What has happened is that there are some other ways of printing these tables of the elements. Some texts list the actinide series that are set out of the bottom row and begin with actinium, and others with thorium. Apparently an "author" was working with the "thorium" type as the text was written, and another editor supplied the "actinium" type of Periodic Table that was put in the book.

P. 167 Critical Thinking...4-c asks students to identify a highly active liquid metal with 1 valence electron. This would be any of the Alkali metals at the right temperature so there are six answers. PH wants only cesium, and will need to fix this in the teacher's edition. (Because cesium is a solid at STP.)

P. 169 has a photo of the particle-accelerator generator at Fermilab. The photo is reversed L/R from Voyage of Exploration 1992, p. 146.

P. 199 has four paragraphs concerning the Statue of Liberty, which are 100%, the same words as PH Physical Science of 1991. It says that the "bronze of her outer structure..." has turned a dull gray-green. She has a copper skin! (As Ms. Caputo conceded Feb 3rd '95) P. 190 of PH Physical Science reiterates the bronze skin. She is copper on p. 203 of EPS -1995.

P. 198 All of the Authors, and all of the Editorial Staff, and all thirty-six of the Content Reviewers missed this. On page 198 the Statue of Liberty is given a full-page photograph, and Prentice-Hall has put her torch IN HER LEFT HAND. To add insult to injury the photo is copied again, smaller, on p. 199.

P. 203 places the torch in her right hand as it is and properly should be. The sculptor probably considered this iconographically and esthetically correct.

P. 223 says that in galvanizing, iron is covered with the "more active metal zinc" to protect iron from corroding. What is the significance of "more active metal"? Generally pure zinc oxidizes in the air slower than ungalvanized iron.

P. 233, figure 9-7 concerning carbon, says "Here you see three different forms of the pure element: diamond, graphite, and coal" and pictures diamonds, pencil leads and lumps of coal. A pencil lead is not a form of the pure element. Pencil leads also include Kaolin or clay as the binder that contributes hardness. More clay and the harder, scratchier, lead produces a fainter line. Less clay and the softer lead produce a darker line.

P. 245 computer-generated model of a human protein molecule has had its picture rotated 90 degrees clockwise when compared with PH Physical Science of 1988 - '91 p. 251.

P. 257 lists aspirin as one of the applications of synthetic polymers. The aspirin tablet is pictured with rubber tires and plastic raincoats and an umbrella. The aspirin is the only one that breaks down in water (I did the experiment). I (HPL) asked my daughter Kathy who is getting a PhD in Organic Chemistry, and her response was "No, Dad!!!" My pharmacist said "No." Suggested I try 1-900-4200-ASK, which is Ask The Pharmacist. They said "No." Also, Merck catalog never mentions polymer, and molecule as shown has no repeating monomers. I asked Ms. Caputo. Ms. Caputo of Feb. 3rd, 1995, tells me that my confusion with the use of aspirin as an example "comes from semantics". She then gives me a long explanation that aspirin tablets do not occur in nature. "Furthermore, commercial aspirin is composed of acetylsalicylic acid which is prepared from acetic and salicylic acid. It is the salicylic acid that actually counters the pain, but unfortunately salicylic acid is irritating to most stomachs. Chemically combining it with acetic acid makes aspirin much gentler on the stomach." Maybe she confuses a buffering chemical with acetic acid. I doubt acetic acid helps a stomach much.

P. 631 of PH Physical Science of '93, '91 and '88 says aspirin is an ethylene product. I haven't asked Ms. Caputo to explain that. Perhaps the original material suggested that a plastic aspirin CONTAINER was an example of an ethylene product.

P. 259 Scientist is reversed L/R from '92 Voyage of Exploration p. 197.

P. 265 reads "energy levels" at bunches and bunches of watts. A watt is a unit of power, not energy.

P. 277 says, "Transuranium elements (also known as synthetic elements) are those with more than 92 protons in their nuclei." There are synthetic elements with

fewer than 92 protons in their nuclei.

P. 277 has another Fermilab photo, also reversed L/R from Voyage of Exploration, '92, p. 146.

P. 279 does not have the radon percentage drawn to same scale as the rest of the graph. Ms. Caputo defends it as sufficient inasmuch as the percentage is written on the graph. A common means for propaganda is to distort graphical data

P. 285 electroscope photo is reversed L/R. Read the warning. It is correctly shown in PH Physical Science of '88 & '91 on p. 272.

P. 286 Spiderwort is described as nature's radiation detector. "The stamens of the spiderwort flower are usually blue. In the presence of radiation the stamens turn pink." In the included picture the only portion of the stamens on which color can be discerned reliably are yellow. What does that mean? Same photo is in PH Physical Science of '91 on p. 273, and in Voyage of Exploration of '92 on p. 145 it is rotated 90 degrees counterclockwise.

P. 290 discusses the Half-Life of a Sugar Cube. It should be the Half-Life of a lot of Sugar. (250 sugar cubes have one face colored; students spill them onto the table and remove each cube that has colored face up. Spill and remove again. The spills are each called tosses. (Each cube lives or dies...and cannot be half alive). Students are asked to balance 40 cubes (plus or minus) in a vertical column (this classroom will be active!) Dice will work much better; they will last longer, and will not make a mess.

P. 291 discusses binding energy as a force. Energy is not a force. "The decay of a radioactive element occurs at a fixed rate called the half-life." Half-life is a period of time and not a rate. "The Geiger counter can also measure radioactivity." (So can an electroscope, a cloud chamber and a bubble chamber.) (Ms. Caputo says this has already been fixed for reprint)

Teacher's wraparound says shape of sugar cube graph here will be a "hyperbolic

curve in the first quadrant, asymptotic with respect to the X-axis". No, it is an exponential curve asymptotic only to the X-axis. It begins at the point 250 on the Y-axis. A hyperbola is asymptotic to two lines and is not related.

Wraparound further asks students how this would work with tetrahedral, dodecahedral or icosahedral regular solids instead of the cubic regular solids. What side comes up when you toss a tetrahedral?

P. 292 multiple-choice question 8 asks what an artificially produced radioactive isotope of an element is called, and lists two partially correct answers: A. Synthetic isotope and C. Radioisotope. Ms. Caputo on Feb. 3, 1994, says, "A radioisotope is simply an isotope with an unstable nucleus that spontaneously emits particles and electromagnetic radiation. A synthetic isotope is one created from nuclear transmutation." The synthetic isotope is the answer she says. Is it not possible to produce a stable isotope of something or other? That would NOT be the answer.

P. 293 asks why it is more dangerous for a woman of childbearing age to be exposed to nuclear radiation than it is for a younger or an older woman to be exposed. To an actuary of our acquaintance the statistics look like it might be a cumulative effect as far as the women go. He wonders if the danger being questioned is danger to the woman, or danger to the woman and her possible unborn child(ren). Ms. Caputo explains that women of childbearing age are more at risk because of the hereditary material inside her eggs. Not true. Girl children under childbearing age already have the hereditary material in their eggs. It is a function instead of the faster growing tissues in women of child-bearing age...things like endometrial tissue, ripening eggs, etc. Things that grow faster are more susceptible to damage from radiation. That's why radiation is used on tumors. That's why hair loss often occurs to patients undergoing nuclear therapy.

P. 300 See Motion, Forces, and Energy 1993. The material is the same there on page 12. Navy Fighter Jet's relative speed with respect to each other is irrelevant. It is necessary that they have same velocity as the re-fueling tanker. EPS 1997

replaces this scenario (correctly) with Mir and Atlantis.

P. 301 See TTL May/June '93 re: Fred Astaire in Motion etc. on page 13 there, teacher's manual. Figure 12-3 asks students how Fred Astaire can dance on the ceiling in the movies. Teacher's manual says the "actor stays in one place, but the background is slowly rotated. When the film is shown, it is turned upside down so that the actor appears to be on the ceiling." TTL spoke with the studio. The set...AND THE CAMERA were rotated AS A UNIT and Astaire danced on whatever was down at the time including the walls. Good thing to discuss in teaching "frames of reference" but PH fails to do it.

P. 301 student text asks, "How is it possible that an actress can be shown dancing on the ceiling in a movie?" and the teacher's manual answers it, "The actress stays in one place, but the background is slowly rotated. When the film is shown it is turned upside down so that the actress appears to be skating on the ceiling." Changing Fred Astaire's sex doesn't fix this question. Rotation has nothing to do with it. Build the set with a chandelier on the down side of the room on a welded chain. Camera goes upside down. Actress dances. Develop and show the film. Or shoot the dancing against an "invisible blue" background and electronically manipulate the image onto whatever background fits. Students can understand the Royal Wedding tricks, but not if they're "helped" by this text.

P. 303 Figure 12-5 is NOT a scale of any type contrary to its labeling. It is only an ordering. Ms. Caputo says equal increments are not needed. Voyage of Discovery, p. 536, omits the cyclist, and is therefore much closer to a real scale...a log scale. The log scale used for showing electromagnetic waves covers 50 octaves. There it is successful, and thoroughly appropriate. It should be here as well.

P. 307-308 has one rowing a boat at 16 km/hr. This is not a realistic rowing speed for the rowboats familiar to most of us. The same material is found in PH Physical Science of 1991, p. 294.

P. 309. Sonar on the ship could not "see" the treasure chest; it's too small. PH

Physical Science 1991 uses a ship on the ocean floor which is more appropriate.

P. 310 asks students what is needed to calculate final acceleration of a roller coaster. They have no basis to figure this out. The rate of change in velocity with respect to time is known as acceleration.

P. 311, "When a roller coaster climbs a hill, it decelerates because it is slowing down"! Circular.

Figure 12-13 has a "professional drag-strip race" described. It is totally fictional. Students are asked to compute the acceleration of the Race Car. The acceleration answer is wrong in the teacher's manual (5 m/sec/sec (sic)). In addition, the units should be expressed as "m/s²". Furthermore, students have no basis to compute this figure. This same error occurs in PH Physical Science of 1991 on p. 296.

P. 312 Circular Motion. This discussion bunches together rotating and revolving objects with silly results. A spinning flywheel for instance has a net velocity of zero for instance (regardless of what PH says.)

P. 315 "The stopping distance of a car is directly related to its momentum." The stopping distance depends on the kinetic energy that is proportional to the velocity squared. "Momentum is always conserved." This is true only in an isolated system as indicated earlier on the same page.

P. 315 in teacher's manual has an activity about "Jerry's large cart." Another cart that looks "exactly like Jerry's" passes it. Students are to conclude that the "second cart has more momentum, and so it must also have more mass or velocity or both than Jerry's cart."

P. 320 "If a motorboat travels 25 km/hr down a river whose velocity is 4 km/hr..."

P. 321 Critical Thinking #3 has a 10 kg train car moving 14 m/s (over 30 miles

per hour!), toward an approaching 10 kg train car moving 10 m/s. Not only that but these cars are too massive for model train cars, and too tiny for real ones. This is similar to that given in PH Physical Science of '91 which has lesser values on page 303.

P. 323 repeats common mistakes in the Newton biography. In PH Physical Science of '88,'91 and '93 p. 305 for instance Newton was "a student and teacher at Trinity College in London" when he was forced to return to his mother's farmhouse in Woolsthorpe. In EPS 1995 it says that the year was 1665. "Throughout London, schools and businesses had closed. The deadly bubonic plague raged through the city, causing twenty-two-year old Isaac Newton to return to his mother's... ." Trinity College is part of Cambridge University, and is still located at Cambridge about a hundred miles away from London.

P. 328 "Automobiles are able to stop because the action of the brakes increases friction between the tires and the road." Not true. On the same page we read "Cyclists rely on friction to hold their bicycles on the ground during turns" which is also not true. It's the banked track that is important. Continuing on the same page we read, "Cars often skid on icy streets because the smooth surface of the ice reduces the friction between the tires and the road." The tires do not even touch the road, which is the real problem.

Ms. Caputo in Feb 3, 1995, points out that the "caption does not even refer to a banked track." This is true, yet the illustration IS a banked track.

P. 38 of Motion, etc., Teacher Edition, has the question, "Why would rolling objects produce less friction than objects?" The sliding answer given is that "Student responses might include that the wheels are round and move better and that there is less surface touching another surface." This is wrong. In the teacher's manual of EPS p. 326 the same question is asked and the student response sought appears to be that the sliding of surfaces is "converted to rolling."

P. 329 says Isaac Newton "recognized that if friction was not present, an object in

motion would continue to move forever". Prentice-Hall Physical Science of '91 says the same. Actually we are indebted to Galileo for this.

P. 330, Figure 13-10 says, "Sled dogs join together to exert a force great enough to overcome the inertia of the sled. What would happen if the team stopped or started suddenly?" Friction is the main reason for all those dogs. Static friction is the toughest. One dog, Buck, in Jack London's Call of the Wild is enough to overcome the static friction of the sled and move it the distance to win a bar bet. Without friction a single Chihuahua can accelerate the sled. After the inertia is overcome and the sled has obtained cruising speed will the dogs be able to ride from Nome to Fairbanks? No, they must overcome friction most of the way, and they must lift the sled up hills, etc. The term "overcome inertia" is used several times in the Prentice-Hall literature. How does one know when one has "overcome inertia" and finished the job? When the sled is going 2 km/hr, 6 km/hr, or 20 km/hr?

In Janice VanCleave's Physics for Every Kid, copyright 1991, John Wiley & Sons, Inc. with ISBN 0-471-52505-7 for the paperback, and 0-471-54284-9 for the library binding we have Experiment #56 on page 132 - 133 which has a 2-liter pop bottle pulled across the table with a rubber band "To demonstrate the effect of weight on inertia." The stretching of the band is compared when the bottle is filled with water with when the bottle is empty. The band stretches more when the bottle is filled with water. The explanation is as follows.

"WHY? Inertia is the resistance to motion. The rubber band stretched very little when moving the empty bottle because the bottle has very little resistance to being moved. The water-filled bottle is heavier and resists movement more than does the empty bottle. As a result, the rubber band stretched more when moving the heavier, water-filled bottle. As weight increases, INERTIA increases."

Inertia increases proportional to mass of course. The smaller mass has less inertia, and therefore less resistance to being accelerated. Friction is a real problem here. Why isn't this result an indication of the increased frictional resistance?

P. 331 has a clear and cogent explanation of Newton's Second Law of Motion. The grocery cart is still here, empty or full, but the hill is not, and the explanation is much better than that on page 43. How do the students learn which explanation to refer to?

P. 333 Fig. 13-14 Canoe and Paddler move FARTHER than the Jumper. It should be proportionately less motion, in fact, inversely proportional to the masses involved. Walt Disney Studios does this better as early as Snow White when the Chipmunk sneezes in the Bier stein as the animals help to clean up the cottage.

P. 337. What is the terminal velocity of a dime? Terminal velocity of skydivers will be discussed later. Surface to mass ratios will be discussed. Throughout this material on falling objects PH will turn air resistance on and off without notice. Be careful.

P. 338 asks how "insects can fall from tremendous heights, yet walk away unharmed" and suggests comparing their masses to their surface areas. This is good.

P. 340 Speeding snowball. What is the terminal velocity of a speeding snowball?

P. 341 says, in the teacher's edition that gravity differs in different places. It is the acceleration due to gravitation that differs. "Gravity" is the name of the phenomenon to be investigated.

P. 344, laboratory investigation, "Will an Elephant Fall Faster Than a Mouse?" includes dropping an uncrumpled piece of paper from shoulder height to see how fast it drops in comparison to a crumpled piece of paper. Starting posture of paper makes a big difference. One can manage both faster and slower descents with flat paper. Tightness of crumpling makes a difference. It would be informative to the students to include a taped-shut pad of notebook paper the same size as the wood block and the Styrofoam pad that are dropped. What is missed here is that there is a difference between velocity and acceleration and taking into consideration the

effect of air resistance.

P. 347 has a series of questions that include #7 Concept Mastery, "Why does a raindrop fall to the ground at exactly the same rate as a boulder?" It could when it has the same area to mass ratio...depending upon its size. It cannot if they're the same size because the raindrop has higher area to mass ratio, and this makes a difference in air. In a vacuum the raindrop will immediately turn to gas...subliming if necessary. If that sublimation is ignored then they fall at the same acceleration only in a vacuum, although vacuum is not stated.

Critical Thinking #3 says, "Suppose a 12-N force is required to push a crate across a floor when friction is not present. In reality, friction exerts a force of 3 N. If you exert a force of 7 N, what size force must your friend exert so that you can move the crate together? 8 Newtons. But why do I need a friend to exert a total force of 15 Newtons? That's less than the weight of a half-gallon of milk. Why exactly 12 Newtons? How much acceleration does this crate require? Ms. Caputo says PH will consider changing values to more realistic ones in the future, but points out that "the force is required to move the box because of its mass."

Critical Thinking #5 says, "A heavy object is dropped from the top of a cliff. What is its velocity just before it hits the ground after 12 seconds?" 117.6 m/s, but this is more than twice the terminal velocity of the skydiver discussed on pages 338-339. (The skydiver must be in a vacuum). I (HPL) did the math for my refrigerator that qualifies as a "heavy object" and I dressed it in an aviator's brown leather jacket before dropping it mathematically. Because my refrigerator has a higher area/mass ratio than a similarly dressed human it will be slower than the human. PH has turned off air resistance again without telling us. That's not critical thinking.

P. 350 Pressure is NOT a force, which is a point not clearly made although the equation does get it right.

P. 351 Fig 14-3 metal can has had photo swapped L/R. Compare it with p. 331 PH

Physical Science of '91 & '88. Or look at your own gas can...there are manufacturing standards that are unfair to left-handed people.

P. 352 The girl in Fig 14-4 has been swapped L/R. Compare with p. 331 of PH Physical Science of '91 & '88.

P. 354 Elephant diagram, the mouse's piston has too big an area to balance an elephant. The Way Things Work of Macauley does this better by a factor of ten. An artist could interpose a magnifying glass to "enlarge" the mouse.

P. 355 Fig 14-9 Versus Text. Text says master cylinder piston area is smaller than slave piston area. The illustration shows the master cylinder piston area as larger than the slave piston area. Real life pistons go both ways. Maybe a waterbed would be a better illustration.

P. 356 Fig 14-10 shows a pool sketch with 5 different levels. Top level has weight of 1. Next level down has weight of 1 plus 2. Next level down has weight of 1 plus 2 plus 3. Next level down has weight of 1 plus 2 plus 3 plus 4. Bottom level, the fifth, has weight of 1 plus 2 plus 3 plus 4 plus 5. A PhD School Administrator concluded therefore that weight of the bottom level was 15. The weight of the bottom level is actually 1. Cardinals and Ordinals have been put into precarious positions in the illustration and invite confusion. Ms. Caputo says that they've been commended by various teachers for providing students with a visual method of comprehending the concept. Those teachers probably came up with 15 also.

P. 358 says Archimedes lived more than 2000 years ago. His dates are typically given as 287? - 212 B.C. Ms. Caputo points out that many students are unfamiliar with working with B.C. dates. Maybe this is the place to introduce them to the concept.

P. 359, Figure 14-13 illustrates an ice cube floating with one corner high. Concerning an iceberg it says that because it floats we know its "weight must be less than or equal to the weight of the salt water it displaces." (Pick one!)

P. 361 Plate tectonics and continental drift has nothing to do with buoyancy.

Pp. 362-3 has a poor and incomplete description of how planes fly and the shower curtain problem solution can't be made with only the material provided in the chapter.

P. 365 has a multiple exposure shot of a tennis ball hitting a racquet. It's not clear that the racquet is moving and it should be.

P. 367 says, "Buoyancy is the phenomenon caused by the upward force of fluid pressure."

P. 368 says, "The weight and motion of fluid particles creates..." Ms. Caputo in Feb 3, 1995, letter says that a student had brought this to their attention earlier, and that the correction had been submitted for reprint.

Multiple Choice #9 says, "When compared with the air that travels under an airplane wing, the air that travels over the wing a. is more dense. b. is less dense. c. moves more slowly. or d. moves faster." Ms. Caputo says d only. However, if students remember the gas laws from earlier in the book then due to Bernoulli there must be a lower pressure above the wing and therefore a lower density.

P. 369 Critical Thinking #1 is talking about air pressure and asks "What would be the force if the tabletop were twice as large?" Does this mean the tabletop goes from a 2-foot square to a 4-foot square? Alternatively, does it mean that the tabletop goes from 2 square feet to 4 square feet?

P. 369 Critical Thinking #2 suggests floating a mystery material (gold or pyrite) on mercury to determine which it is. Because gold dissolves in mercury this procedure is as intelligent as using a hammer to determine whether or not a sample is antique Venetian glass or modern American Plexiglas. PH Physical Science of '93,'91 & '88 suggests the same experiment on p. 345.

P. 369 Critical Thinking #4 asks students to, "Describe how you could make a sheet of aluminum foil float in water. How could you change its shape to make it sink?" And the teacher's edition wraparound says when there is a higher ratio of area to mass it will float better. Try this experiment: Submerge a sheet of foil, and crumple it tightly so that it will sink. Staying underwater un-crumple it until it floats. Do this on videotape and send it to Prentice-Hall because they need to prove their hypothesis about the area/mass ratio.

P. 369 Critical Thinking #5 says, "A barge filled to overflowing with sand approaches a bridge over the river and cannot quite pass under it. Should sand be added to or removed from the barge?" Teacher's manual says to add sand. If it is already filled to overflowing just how will that work?

P. 373 Calculating. The teacher's edition asks students to calculate how much work a woman does if she lifts her suitcase, and carries it for 25 meters, and how much work she does if she drags it. The teacher's edition says, "The total work in both lifting and dragging is 2550 joules." Work is done only in lifting.

P. 378 "For example, when you use a shovel to move a rock, your effort is opposed by the rock's weight." Not true, the shovel opposes your effort.

P. 379 says, "work is conserved." It's not. Energy is conserved. See also page 410. The teacher's manual has a multicultural note on Elijah McCoy that is mostly false.

P. 384 gets into mathematical trouble. Discussions concerning which lever "multiplies the effort force" or "which lever multiplies the distance of the effort force" seems to require that multiplication always INCREASES things, and this is not always true.

P. 407, Fig 16-14, is a stylized coal fired electrical generator 1940's art-deco-reminiscent form of industrial painting.

P. 427 tells students to "Set up a battery, a light bulb, wires, and alligator clips as shown" ... and omits the illustration. Ms. Caputo in Feb. 3, 1995, letter says that they discovered this themselves shortly after the textbook was printed, and that they "have since corrected the problem." In 1997 the instructions are changed to "...according to your teacher's instructions." This will present problems, as the teacher's are likely not to know how.

P. 428 has some hot molecules (red) and some cold molecules (blue) impersonating convection. Unfortunately there is a silly traffic jam. The convection currents on p. 455 are much better illustrations.

P. 428 Discovery has a scenario where students are to determine how to open the window "from the top or the bottom" in order to let air into the stuffy room depending on the outside temperatures. The answer must be "both". A convection current must of necessity include a "loop" for circulation.

P. 432 The banana illustration has been swapped L/R. It is a right-handed banana on p. 401 of PH Physical Science of '88 & '91 and '93. It is also a right-handed banana in the Voyage of Exploration OF '92, '89 & '86 on P. 39. These changes are not necessarily a function of esthetics. EPS - 95 and Voyage etc. both have banana illustration on left hand page...and EPS chooses the left hand banana and Voyage etc. chooses the right hand banana.

P. 437 the calorimeter illustration and procedures have been simplified. Perhaps necessarily, but is this topic appropriate at this level.

P. 442 has another heating curve, or phase-change diagram of water. Here heat of fusion and heat of vaporization plateaus are more carefully drawn. Specific heat of steam and ice is given as 0.5 calories per gram degree Celsius and for liquid water is given as 1.0. These two values are given three different slopes on the diagram. PH Physical Science does a similar 3 color illustration on p. 407 in '93, '91 and '88 and uses one slope for each of the specific heat values. It's difficult to read the phase change graph of PH Physical Science of '84 and '81 because the

length of the vapor form is so short, however, regardless of the correct number value, the slope appears to be less than the slope of the water.

P. 444 says most liquids expand when they are heated, but (on p. 445) "There is one exception to this rule, however" and lists water. Gallium expands as it freezes.

P. 458 says, "Black absorbs sunlight better than any other color." But black is the absence of color.

P. 466 shows a steam engine. Unfortunately the slide valve is drawn OPEN when the piston is on the left, and CLOSED when the piston is on the right. The slide valve SHOULD BE OPEN feeding the cylinder to the LEFT of the piston when the piston is to the left. It SHOULD BE again OPEN feeding the cylinder TO THE RIGHT of the piston when the piston is to the right. This is drawn incorrectly also in PH Physical Science of '93, '91, & '88 on p. 426. It is drawn correctly in Prentice-Hall Physical Science of '84 & '81 on p. 277. Same colors even.

All of the engines as illustrated lack a shaft passer to allow the connecting rod between the slide valve mechanism that connects to the flywheel to pass the axle shaft on the far side of the flywheel.

P. 468's gasoline engine is correctly drawn in the intake stroke. The compression stroke is drawn with the piston ALL THE WAY UP at top dead center, and a directional arrow drawn on the piston (when it is momentarily still). At this time in a real engine the spark would have just fired due to the spark advance. Ignition takes only a short amount of time, however, it is not instantaneous and therefore must begin so combustion is fully initiated as the power stroke begins. The power stroke is shown with the piston ALL THE WAY DOWN at bottom dead center. The diagram also shows the combustion and the firing of the spark plug although that was more than 180 degrees earlier as the crankshaft turns. The exhaust stroke is shown properly. This same drawing is in PH Physical Science of '93, '91 & '88 on p. 427. Ms. Caputo, Dec. 29, 1994 told me that they CHOSE to show the

completion of each cycle rather than at some point in between. This was "so that students could gain a better understanding of the material." She claims the artist's rendering was "based on reliable technical resource material."

Prentice-Hall Physical Science of '84 & '81 gets this right on p. 278. Allyn and Bacon, Inc, Exploring Physical Science gets this right on page 178. These books do show the plug firing during the power stroke it is true, however, it is so close to the start of the power stroke that I have no complaint. EPS-'95 however has the spark drawn when the crankshaft is over 180 degrees away from correct position.

Hot Rod Magazine did this in '95, and Scientific American in '94, Americana, Britannica, Collier's, Grolier's, etc., etc. to more than 20 other print references, several mechanics and all agree. All incidentally show the crankshaft turning clockwise (probably as early motorists saw the crank when they started the car). Only Prentice-Hall of '86 - '95 goes counterclockwise and showed the engine between cycles "so that students could gain a better understanding of the material."

P. 488 defines static electricity as "the buildup of electric charges on an object." Compare this with the glossary, which says it is the "movement of charges from one object to another without further movement." Movement?

P. 491 discusses lightning storms and mentions that tall objects such as trees "also act as grounders". In my Webster's Third "grounder" is a baseball term. The electrical noun is a "ground".

p. 494 teacher's edition says a coulomb is 6.25 times ten to the eighth electrons. The correct value is larger by ten orders of magnitude. It should be 6.25 times ten to the eighteenth.

Also on p. 494 is a sentence that says, "The difference in charge is called a potential difference". Actually, charge is not defined. Also, the "greater the potential difference, the faster the charge will flow" is on this page, but p. 497

shows no apparent difference in the speed of a charge under varying conditions.

P. 495 says "The ampere...is the amount of current that flows past a point per second." This is not correct. This is the same in Prentice-Hall Physical Science of '91 for instance.

P. 497 The American Association of Physics Teachers has an issue using pneumatic and hydraulic analogies that look beautiful. "The Physics Teacher" 34 (3) 188-189 (1996) has an article entitled "Basic Electricity – A Novel Analogy" by Richard Grant and he presents a pneumatic-hydraulic apparatus that does an excellent job of demonstrating hydraulic analogies.

P. 498 teacher's manual asks, "If a different filament with more resistance is used, what should happen to the light bulb? (It should be brighter.)" Not true, it should be dimmer given the same conditions. And also asks, "Why should the bulb be brighter with a filament with less resistance? (More of the electrical energy would be converted into light energy.)" In addition, in the teacher's manual, it says that many people believe that Ohm's law is the most important single electric formula a student will ever learn. Nonsense!

P. 503 has an electrical circuit with the fuse on the return rather than on the "hot" side. Such a circuit is potentially lethal as even with the fuse blown there is still electricity throughout the rest of the circuit and any person who "grounds" the circuit will get zapped. I (HPL) had a house wired this way right after World War One probably by a do-it-yourselfer. I discovered this when I got zapped. My electrician also got zapped. My older kids broke a ceiling fixture. I asked, "Is the Switch Off or On" "Gee I don't know" so I pulled the fuse, climbed the aluminum ladder, started to take off the fixture and got knocked down. I called Fred English, my electrician. He asked me what I had done, pulled the rest of the fuses, climbed the ladder and got blown off of the step. I'll remember this forever. I also learned what present codes require. Losing some physics this has been replaced in 1997.

P. 505 has little relationship between symptoms and what really could happen as

series/parallel errors were made because some of these circuits were planned for the 220-240 volt appliances.

Teacher's manual says "Power = Force X Current", student's book is correct that "Power = Voltage X Current". TTL noted this also in Nov/Dec '93 re p. 36 of Electricity & Magnetism. Voltage does not equal Force.

P. 508 refers students to Figure 1-27 where Figure 19-27 is probably meant. Safety item #6. says fallen wires "often carry very high currents." Voltage is what is meant rather than "current". If you were to become a ground for one of the wires, then it might carry a very high current. This is corrected in 1997.

P. 508 also says "An overloaded circuit can cause a short circuit." More usually an overloaded circuit will blow a fuse. A short circuit most typically causes an overloaded circuit and that causes a blown fuse or tripped circuit breaker. The fusing on any circuit is planned so that an overload will cause an open circuit.

P. 511 teacher's manual says the "lemon setup should produce a current of about 0.5 volts". The lemon setup on p. 510 will produce a voltage of about 0.5 volts. Current is measured in amperes.

P. 521 has a bunch of metal paper clips in Figure 20-7. Left and right have been swapped; the photo was the other way around in PH Physical Science of '88, '91 on page 470.

P. 527 discusses (in teacher's edition) that many people are prevented from seeing the aurora borealis because of light pollution. Most students in the United States (except Alaska) are prevented primarily because of their latitude. At times, the aurora can be seen quite far south, but outside the cities.

p. 528 of the teacher's manual has material that suggests that students draw horizontal lines on a sheet of paper and then tear the paper vertically to represent the concept of magnetic stripes showing the concept of ocean-floor spreading.

The magnetic stripes actually lie parallel to the mid-ocean ridges.

P. 533 Teacher's manual, Issues in Science suggests teacher have students discuss whether or not research in nuclear fusion (which is costly and consuming) because the money and time could be used to address other needs, such as finding cures for fatal diseases. That simply is not the way the world works. This is a little bit like guns or butter during WWII. Cows stayed on the butter side, butter was produced and got to the public through the black market, and we made guns too.

P. 541 teacher's manual says that the strength of any electromagnet depends on the amount of current and the number of amperes. The amount of current IS the number of amperes.

P. 543 says, "The one common element in all Faraday's experiments is a changing magnetic field." Not true.

P. 550 has an Art Deco style generator showing a voltage at the pole of 110 volts instead of 220-240 at the pole?

P. 555 teacher's manual has a discussion of Issues in Science where cooling ponds and procedures for releasing spent steam into the atmosphere from nuclear plants are discussed. PH doesn't know how this works.

P. 559 says that when the filament of a vacuum tube gets warm from electrical current it heats up the electrodes. Not true, it heats only one electrode.

P. 560 Figure 22-2 has photo of perhaps a diode vacuum tube if caption is read carefully. Photo is not a simple diode. Count the pins.

P. 561 "Emitter" and "collector" are terms not used in describing vacuum tubes and are used instead in discussing transistors.

P. 563 discusses "painting thin "wires" on the chip." which is not done.

P. 590, Figure 23-5 piano has been rotated 90 degrees counter clockwise. It is an upright. A piano will not operate in this posture as many of its parts depend upon gravity.

P. 599 says speed of sound in air at 0°C is 332 m/s. P. 617 says 331 m/s at 0°C.

P. 604 has a group of approximate sine waves. Top example in each case all have axis shown above center of wave pattern. True of middle A also. Consequently, bottom row is not the result of combining top plus middle.

P. 614 asks students to determine why the astronaut cannot hear the engine of his lunar vehicle. Lunar vehicle is not a go-cart and does not have an engine. It has four little electric motors. Besides the wanted answer (because there's no atmosphere on the Moon) doesn't work. He can hear the little motors because his suit is sitting on the seat (sound travels through the structural members of the vehicle) and he has a pressurized suit (read that "atmosphere") and will be able to hear the probably faint hums of his little DC motors. I bet PH never talked to anyone who was in this position...but they could and should have before using this example.

P. 617 discusses advantages to Native Americans (actually the Native Americans were wiped out by the Indians) by hearing buffalo through the ground in a quarter of the time as compared to hearing the buffalo through the air. Actually, the sound travels farther through the ground because the ground is a more efficient transmitter, and that is why Indians put their ears to the ground.

P. 621 tuning fork is wrong. Both arms should be the same height above the paper. Pin will not attach with candle wax (was probably sealing wax in an ancient source text). PH told me (HPL) their testers had no trouble with the procedure as illustrated. That would be because they never did it. I sent a \$1000 bet by certified mail that PH could not do this. They've not responded. PH has used this since PH Physical Science of 1988.

P. 622 discusses sound crews servicing jet engines. Ground crews will do a better job.

P. 623 discusses band shells and how they "amplify" music. Actually, they reflect the music. Amplification is something different.

P. 624 has a discussion of acoustic beats. Two sound sources at 50 and 55 Hz will produce beats at 5 Hz. Illustration counts beats where the sound sources reinforce each other AND where they cancel each other. Text reads, "At the first beat, no sound is heard. What happens at the second beat?" Most physics texts for more than a hundred years have counted vibrations from peak to peak - not peak to trough (for the first) to peak (for the second) etc. There was a time in the 1800s when "double vibrations" equaled what is now called one complete cycle. Ms. Caputo has written with a lucid explanation of beats, but it is inconsistent with the diagram.

P. 629 outlines an activity asking students to tighten a guitar or violin string to see what happens to the pitch. Since some violin G strings run over \$50 this is a careless instruction. In addition PH displays ignorance by asking the students to manipulate the "tuning knob." Radios have "tuning knobs". Violins and Guitars have pegs.

P. 632 discusses how larger than normal amounts of energy "are deposited" on material. Can we mine energy deposits?

P. 647 uses a log graph of the type, which Ms. Caputo said would be beyond the students' understanding. It's indeed beautiful and easily understood.

P. 657 says there are three ways in which a luminous object gives off energy in the form of light. PH has explained to me that that doesn't mean that there are not more ways. There are more ways of course: triboluminescence, bioluminescence...to name two more.

P. 662 puts a beam of light through a prism, and puts spectrum on the back wall with colors reversed. PH tells me spectrum is OK, but prism is slightly misaligned. Thermometer should have axis parallel to axis of prism to keep energy from yellow stripe (for instance) from contaminating readings of energy (heat) in the green stripe. Light bulb is an inadequate source of light for this experiment.

P. 665 discusses "luminous lights". The non-luminous lights must be out of the old Charles Addams cartoons where one of the members of the family invents a flash-"light" that puts out a black beam or shadow.

P. 670 Figure 26-2 illustration should be drawn to fit the laws of reflection from p. 601. The angle of reflection equals the angle of incidence. Isaac Newton noted this as his 2nd Axiom of Optics. It was true on p. 601 and its application would be illustrative and appropriate here if properly drawn.

P. 673 Figure 26-6 illustrations of concave mirrors also contradict Newton's 2nd Axiom of Optics. Focal points are in wrong places, and the mirrors appear to be cross-sections of spherical shells - precisely the wrong shape. Even headlights are made in parabolic shapes. The shape need not be named - students need not know conic sections to see that Newton's 2nd axiom is in effect here. I know quantum physics treats refraction and reflection somewhat differently, but in general Newtonian principles work pretty well if properly applied and understood. You basically cannot get light to reflect except as the center beam in any case of figure 26-6 or in the sketch of 26-8 over the page on p. 674. Absolutely the center of the sphere is not the focal point of the spherical concave mirror in any event ever.

P. 677. This is how prisms separate white light into a spectrum. Compare this with p. 662. This is science at its most beautiful, and it is factual in Kansas. On p. 662, it is careless and in the fictitious Land of Oz.

P. 684 asks, "Why would a purple-people eater appear black under yellow light?" Because it eats purple people is no reason to expect it to be purple itself. We eat green beans.

P. 686 eye illustration is reversed left/right when compared with PH Physical Science of '91 & '88 on p. 552.

P. 760 It would seem to make a difference, which battery terminal is positive or negative, and which terminal should go to the key.

P. 786 The discussion of animal safety seems outside the discipline as no animals have been used directly through the text. Oh well, leave it in and remind kids to feed their pets too.

Periodic Table 792 - 793 is a repeat of the other one. Cesium and Gallium are still solids.

794 Glossary, Actinoid (sic) Series repeats that all but three are synthetic. Still no!

795 Glossary, Amplifier: Good definition. Doesn't fit explanation of "amplification" alleged to be caused by band shells on page 623.

Atomic Mass Unit - A proton has a mass of 1 amu here, but see masses of the proton and neutron on p. 126. In beta decay a neutron breaks down into a proton and an electron plus some energy. When proton and neutron each have a mass of one amu then, in the process of beta decay we create both mass and energy.

LINEAGE OF EXPLORING PHYSICAL SCIENCE

Traced through reviews and some state adoption proceedings the lineage of EPS is interesting.

November - December, 1992 The Textbook League's "The Textbook Letter" reviewed THE NATURE OF SCIENCE, 1993 and the review is entitled "This Book Is a Piece of Junk".

Nov/Dec '92 "The Textbook Letter" reviewed MOTION, FORCES, AND ENERGY, 1993 and the review is entitled "What a Display of Ignorance".

December 3, 1992, The State of Indiana adopts the nineteen texts of PRENTICE-HALL SCIENCE, copyright 1993, from July 1, 1993 to June 30, 1999.

Jan/Feb '93 "The Textbook Letter" reviewed HEAT ENERGY 1993, ... "I Weep for the Students".

Nov/Dec '93 "The Textbook Letter" reviewed ELECTRICITY AND MAGNETISM 1993, ... "This Book Is an Insult".

Mar/Apr '94 "The Textbook Letter" reviewed all of the above in their 1994 versions to determine which improvements had been made. Very few. The review was titled "The Books Are Still Junk, the Claims Are Misleading."

1994 Florida's adoption committee voted down (four to three) PRENTICE-HALL SCIENCE: PHYSICAL SCIENCE, 1994 edition "inaccurate in content" (Source: committee minutes.) Paperwork indicates there had been a pilot in California.

Fall of 1994, Millcreek puts into service, EXPLORING PHYSICAL SCIENCE, 1995...ostensibly a different book with no prior dates or antecedent texts identified. It includes all the above. (Plus CHEMISTRY OF MATTER, SOUND AND LIGHT, and MATTER: BUILDING BLOCK OF THE UNIVERSE)

Sep/Oct '95 "The Textbook Letter" reviewed EXPLORING PHYSICAL SCIENCE, 1995. "Educators Should Avoid This Book Like the Plague"

June 1st, 1996 South Carolina adopts EXPLORING PHYSICAL SCIENCE, 1995

November 12th, 1996 Florida adopts 2nd edition of EXPLORING PHYSICAL SCIENCE 1997.

CHEMISTRY OF MATTER distinguished itself in 1993 and 1994 versions with a full page flopped photo of the Statue of Liberty. EPS did the same on the analogous page in 1995 and in 1997 edition's first printing. EPS 1997 second printing includes a photo of Linda Ronstadt labeled as a silicon crystal doped with an arsenic impurity. From 1995 to 1999 in EPS (like PHS 1993 - 1997) the Periodic Table of the Elements retains 109 elements although there were more by 1994.

SOUND AND LIGHT states that the angle of reflection equals the angle of incidence and then breaks that law in 12 of 15 illustrated reflections involving curved mirrors. The 3rd edition presents plane mirrors this way: A dog faces an observer and sits with his tail to the mirror. The dog's image "through the looking glass" can be seen by the observer and that image also faces the observer! If you see the back of your head in your mirror that would be equivalent!

MATTER: BUILDING BLOCK OF THE UNIVERSE gives definition of atomic number as the number of protons in an atom's nucleus. The atomic number of a beta particle is given as -1. This is so stated in 1993, 1994, 1995, 1997 and 1997. This is a convention that should be made explicit. Whatever the real definitions are, they eventually must make sense.

Material in EPS can be traced farther back to PRENTICE-HALL PHYSICAL SCIENCE, first out in 1988, and PRENTICE-HALL General Science A VOYAGE OF ... first out in 1986. Different authors!

April 1997 The Independent Commission on Environmental Education, 1730 K St NW, Suite 905, Washington, D.C. 2006 put out the study "Are We Building Environmental Literacy?" ISBN 1-878831-05-4 which specifically points out other members of the 19 book series, Prentice-Hall Science, specifically Ecology; Earth's Living Resources, Ecology; Earth's Natural Resources; and Exploring Earth's Weather, products of the same team apparently, and subject to the same weaknesses. 1(800)992-0671.

About 1997 Texas adopts the third printing of the 3rd edition of the Texas edition.

Alabama's contract on EPS-95 for use in grades 9 - 12 goes to the year 2002 per <http://www.alsde.edu/clrmimp/textbooks/textlist.html> (click on science and scroll to Physical Science). This URL is as of 7-1-99. In addition, Oregon may have adopted EPS - see ABC News 20/20, April 2nd, 1999.

About late September 1999, Project 2061 releases preliminary results of Carnegie study of science books. PHS Physical Science material is ranked at the absolute bottom.

Circa 11-99 A copy of the North Carolina School Price List 1999 that covers the Science Texts K-8 and 9-12. EXPLORING PHYSICAL SCIENCE and PRENTICE-HALL SCIENCE for the first time I'm aware of are listed with authors as "Editorial."

Circa 11-1-99 EPS 1999, teacher version, 3rd ed. 2nd printing. Most errors continue.

There remain hundreds of errors in the 3rd printing of the 3rd edition of EXPLORING PHYSICAL SCIENCE 1999 ISBN 0-13-435873-2 which is still in use all across the country. Prentice-Hall's PHYSICAL SCIENCE (Appenbrink et. al.) of 1981 and 1984 is a much more accurate text.

The Baltimore Sun's Jan 31st, 1999 three page article ("It's in the Book and It's Wrong", by Marego Athans and Gary Cohn listed many errors. (Go to www.sunspot.net and click on <archives> to order a copy.) A couple of months later Pearson Education, Prentice-Hall's new owner, promised that all the errors would be corrected and updates would be posted on the web by the end of 1999. The press release is at <http://www.pearsoned.com/pr/32599.htm>. The site is http://www.phschool.com/curriculum_support/openbook/science/index.html but it hasn't even posted updates on the new elements synthesized since the 1993

edition of PH Science. Only a few long-standing errors are addressed. This site is a sham.

This material was adopted in all twenty plus states which do adopt except initially Florida which had a responsible individual on their team in 1994 and adopted NO middle school physical science texts. In 1996, Florida joined the rest.

In early February 2000, we purchased SCIENCE EXPLORER 2000 (3rd printing of the 1st edition teacher version), a 15- volume middle school science set (labeled A through O), from Prentice-Hall. This has been cobbled together into the 2001 3 volume series California voted to adopt on the date of the lunar eclipse in January 2000. Periodic table lists 112 elements that will never be correct in 2000 or 2001 now that numbers 114, 118 and 116 were synthesized in the first half of 1999. The publisher is again caught by its own copyright inflation. Of course, all of this is simply to point out that the publisher is trying to sell books by suggesting that they are up-to-date. This is nonsense and totally irrelevant to the intended audience. The simplest thing to do is to point out that scientists are continuing to fabricate new elements in the laboratory and publish a Table that is quite suitable for Middle School.

Fortunately, the 1st printing was not intended to go into classrooms, being labeled for promotional use only. (It had a geo-synchronous satellite parked over Pennsylvania. Later printings place these satellites in possible equatorial orbits. Any satellite must go around the system's center of gravity. If some of its orbit is north of the equator its other half must be south of the equator. It becomes geo-synchronous only at the right speed and distance above and basically concentric with the equator.) A frustrating good is that a number of errors noted in EPS and PHS have been fixed for this series, but those necessary corrections have not been made on the web site or in later printings of EPS. For instance the steam engine in SE's Motion, Forces, and Energy, '00 Vol. M, p. 188 properly vents spent steam through an open slide valve rather than through a closed slide valve as in EPS on p. 466 in '95, '97 and '99 through the 3rd printing, as in PHS, Heat Energy on p. 54 in '93, '94 and '97, and as in PH Physical Science on p. 426 in '88, '91 and '93. For the record the PH Physical Science of '81 and '84 got it right on page

277. And for the record, no author's name appears on more than two series. This error continued in editions and printings from 1987 through 2000 (the 3rd printing of EPS 99 was done in 2000) in spite of changes of authors.

Unfortunately, some of the same errors have been re-drawn and repeated in the Science Explorer set. Voltmeters showing input voltages on step-up and step-down transformers are connected in series rather than properly in parallel. This is true of PHS Electricity and Magnetism p. 79, EPS p. 549 and SE Electricity and Magnetism, Vol. N, p. 95

The physical science portion of the SE series has been assembled into a text called Focus on Physical Science, copyright 2001, which California adopted in January 2000. Focus on Life Science and Focus on Earth Science are assembled from the rest of the SE series.

Too often, a concept will be explained by a real life circumstance and it then becomes apparent that the writer understands neither the concept nor the real life circumstance. SE Chemical Building Blocks, Vol. K, p. 54 - 55 explains gas laws in terms of a basketball left out overnight in the cold. In the morning when the player tries to dribble, the ball goes to the pavement, and "...splat, it just stays there because the volume of the air inside decreased, chilled by the cold winter air." No way! There's still a basketball full. Gases fill the space available. The pressure drops about 10%. And, "...the ball will return to its full volume in the warmth of the school gym." No, the ball is OK even cold. You can still dribble a basketball fresh from the deep-freeze. It's a little stiff because the rubber is cold. I (HPL) did. My friends did too. You can too. Prentice-Hall's people can too, but they didn't.

Discover Science, M. R. Cohen, T. M. Cooney, C. M. Hawthorne, A. J. McCormack, J. M. Pasachoff, N. Pasachoff, K. L. Rhines, and I. L. Slesnick, Scott Foresman and Company, Glenview, IL, 1991.

This text is part of the Discover Science series and is intended for use by fifth grade students. It has reasonably balanced coverage of life science, physical science, and earth science as well as two chapters on health. The Life Science Unit has chapters on Classifying Living Things, Plant Processes, Invertebrates and Vertebrates, and Populations and Communities. The Physical Science Unit covers Investigating Matter, Heat, and Temperature, Changing Forms of Energy, and Energy Resources. The Earth Science Unit has chapters on the Earth's Changing Crust, Protecting the Environment, and Climate.

Each chapter is organized into 3 to 5 lessons each ending with review questions. These questions are for the most part answered directly in the previous reading material, but there are some questions that require integration of ideas. The same is true of the end of chapter questions. As is true of most elementary texts, the questions place too much emphasis on word meanings and not enough on understanding concepts. Occasionally students are asked questions which are beyond their experience. For example, after an activity in which students experiment with the electrical force between two charged objects, they are asked, "If we blow up a balloon and rub it with a piece of wool cloth, the balloon will stick to the wall. Explain why." This case of the attraction between a charged object and a neutral one is conceptually far beyond what the students have done. On a positive note, there are open-ended questions at the end of each chapter that require students to write a paragraph. These should be very helpful to teachers in determining if the students have assimilated the concepts as long as they realize that there is often not one "right" answer.

There are three activities in each chapter: one very simple one at the beginning and two more detailed ones later. About one third of these activities involve measurement or other quantitative skills. The rest only involve doing something and observing what happens, but at least the observations are well structured. In general, the activities seem to be

grade level appropriate. They are closely related to the topic of the lesson and the connection should be obvious to the students, yet the activities are never referred to in the textual material. This seems to be a lost opportunity to consolidate the learning that has taken place. While much better than experiments in some elementary science books, the activities often stop short of what could have been done with the lesson. For instance, in an activity on physical change, students are asked to observe what happens when one mixes baking soda and calcium chloride, then what happens when water is added, yet it never suggests comparing this to what happens when water is added to each material separately.

With one major and a few minor exceptions, the content of the book seems to be developmentally appropriate for fifth graders. The major exception is the treatment of atoms and molecules. Fifth graders are barely ready for the idea of matter as particles. They are certainly not ready for the parts of an atom, the periodic chart, molecules, and formulas. The National Science Education Standards (National Academy Press, Washington, DC, 1996) state that even through eighth grade "few students can comprehend the idea of atomic and molecular particles." The minor exceptions include the difference between heat and thermal energy and the introduction of fission and fusion in the Energy Resources chapter.

The number of new concepts introduced per chapter is appropriate as long as one does not try to cover the entire book. For a typical school year, covering the book works out to about 2.5 weeks per chapter, which is adequate for some chapters but certainly not for all. The text could benefit from more examples to help make the concepts concrete. The book contains many colorful pictures for which the relevance to the discussion is obvious (unlike some books in which even an adult may puzzle over the connection). The book does work hard at making connections to real life by discussing things like power plants, lightning, and the operation of fuses. However, it manages to connect to the kids'

world as opposed to the adult world.

On a careful reading of the physical science section of the book, there are no gross errors of fact. However, as with all elementary science books, there are statements that are incorrect primarily due to imprecise language. For instance, the chapter on electrical energy contains several minor errors. It speaks of using power rather than energy. The spark which one may see as a result of a build up of electric charge is referred to as a "form of electricity" when in fact the spark itself is light. At one point the student is told, "The flow of electrons is electricity, which carries electric energy from place to place", which causes me to envision an electron picking up a bucket containing a certain amount of energy from the battery and delivering it all to the light bulb. However, while annoying to a physicist, none of these statements will do serious harm to a child's understanding. Overall, this book was found to contain fewer errors than other elementary science books reviewed.

Each chapter also contains several ancillary sections aimed at broadening the students' perspective on the topic. Each lesson has a "Find out on Your Own" section that usually contains suggestions for library research. There is a "Skills for Problem Solving" section, which focuses on the traditional science process skills such as classifying, measuring, graphing, and interpreting data from tables or graphs. Although intended to teach the process skills, they do utilize the concepts from the chapter. Each chapter ends with a one page section called "Science and People", which discusses a scientist and his or her work, or "Science and Technology", which focuses on a case in which technology has been used to solve a problem. In general, these are well done, although the people ones tended to be better than the technology ones. In addition, at the end of each unit, there is a one-page section on careers and one called "How it Works". The careers sections discuss several careers related to the topic of the unit and include information about what a person in that career does and how much education is required. The one in the Physical Science Unit has paragraphs on physicists, heating mechanics, power

plant operators, and air pollution inspectors. The "How It Works" sections are the worst single feature of the book and should have been omitted. The topics addressed are microscopes, television, Geiger counters, and allergy medicines. In all cases, the explanations are both poorly written and far above the level of understanding a fifth grader would have of the background concepts.

One unusual and positive feature of this book is a section at the beginning of the book on Scientific Methods, which goes much beyond stating the usual 4 steps, and a section at the end of the book called "Using Scientific Methods", which provides an additional experiment for each chapter. These experiments are introduced in the context of someone having a problem to solve. The experimental procedure is given and students are encouraged to collect their own data, but the results the person in the story obtained are also provided. Students are then asked questions about what conclusions they can draw from the experiment, why certain things were done, and how the conclusion would be effected if something had been done differently. These will form a very nice addition to the students' learning experience if the experiments are done, but are probably still useful even if they aren't.

In summary, this book is an acceptable fifth grade science textbook. While not perfect, it contains fewer errors than many of its competitors. In addition, while clearly it is a textbook not a hands on curriculum, it does have experiments in each chapter, which will help students understand the concepts being studied, and the experimental nature of science.

Other Things Considered

1. Paul Hickman (p.hickman@nunet.neu.edu) has been evaluating several new efforts at developing new elementary school curricula using criteria described at <http://projects.terc.edu/impact/template/resources/msthtml.cfm>.

These materials are not yet competitors for the texts that we have been looking at.

2. The UMass Physics Education Research Group is developing a program *Minds on Physics* published by Kendall/Hunt at about the 8th or 9th grade level. The first three volumes already published will provide an excellent resource for Middle School teachers. The authors are using the latest results from the efforts of the Physics Education Research (PER) community.

3. A more traditional but highly accurate and acceptable approach is contained in the *Robinson Self-Teaching Home-School Curriculum Version 2.0* which is designed for grades K-12 and is contained on 22 CDs available for just under \$200 available from the Oregon Institute of Science and Medicine, P.O. Box 1279, Cave Junction, OR 97523.

4. *Integrated Science, Book One & Book Two* published by J.M. LeBel Enterprises in 1994, while not a big seller is quite good. Each volume has fewer than 250 pages.

Conclusions

1. **Scientific Accuracy:** Not one of the books we reviewed reached a level that we could call “scientifically accurate” as far as the physical science contained therein. The sheer number of errors precludes such a designation. While we were not looking specifically at the biological component of the texts, there were obvious errors there also. We were not looking for typographical and grammar errors, but many were noted and have not been reported. Many of the obvious errors could be easily corrected, but the subtle errors (including misuse of technical words or phrases, the promulgation of ideas not validated by scientists, and promotion of “politically correct” views) that would leave incorrect implications would be more difficult to root out.

2. **Adherence to an Accurate Portrayal of the Scientific Approach:** There were many instances where there were hints that there is an approach to solving problems that could be labeled “scientific,” but no text emphasized and reminded the reader that the scientific approach was something to be learned and applied,

perhaps even outside the science classroom. There were a few disconnected instances where it was suggested that students “design an experiment.” Some texts had many activities and in many instances, they were good ones, but there was no clear-cut point to the activity. Follow-up questions tended to be trivial and were not incisive and geared to encourage further thinking and coming up with an improved experiment. At the core of Middle School science there should be material dealing with how to ask good questions, how to design ways to get answers to the questions, how to gather equipment needed to carry out an experiment, how to record results, and how to interpret them. Measurement is very important and there were few instances where students were taught how to use instruments. Orienting and reading a meter stick properly is an important skill. Most college students have to be taught this skill because introductory exercises show that they do not know how.

3. **Appropriateness and Pedagogic Effectiveness of the Material:** Without a thorough grounding in measurement making and scaling and some simple mathematics, introducing atoms and molecules (including DNA) into the Middle Schools is a mistake. The diagrams that appear in the texts are quite confusing. The nucleus is drawn large and the electron very small, but nowhere is it pointed out that, this is mass representation and not a volume representation. Students are then surprised to learn that nuclei, even very massive ones, are very small. Astronomy is very difficult (but easy to make simple questions for students to memorize answers to) to do well, but there are excellent exercises having to do with the Sun and Moon over extended periods for this level of student. Why Daylight Savings Time? What does it do for us? What can be observed at the equinoxes and the solstices? Measuring and plotting are what is needed, but none of the books reviewed suggest this. Very little of the mathematics (ratio and proportion, graphing, even addition and subtraction) that they have been learning is being put to use. The Periodic Table has a wealth of material already laid out, but instead of looking at boiling points and freezing points, color, texture, phase at room temperature, etc., the texts worry about electronic configurations and whether they have the latest number of atoms on their chart. The net result is that students come away memorizing a great deal of material that they regurgitate on tests that emphasize recall and think that they know science.

4. **Readability:** We generally are not experts at determining reading levels,

however, we felt that generally the reading level was simple (short sentences and easy vocabulary.) As a check we scanned several randomly (in some cases the first one or two choices were ignored as there was too much non-textual material) pages and read them into Microsoft Word™ and ran the Spelling and Grammar checker to get the Flesch-Kincaid Grade Level. Most of the pages including those of the books that were designed at the 8th and 9th grade level came out at less than Grade 6.0.

5. **Attractiveness and Quality of Illustrations:** The books are beautifully done. Most of the budget must have gone into color, photographs, graphic artists, archive searches, and the like. Rarely does a page not have something in color and often five or six color photographs or drawings or diagrams appear on a page. The quality of the illustrations is excellent, even though not always appropriate. An adult, not conversant with science, picking up one of these books would be very impressed. On hearing that the latest nuclei forged in laboratories are mentioned in the book, that the latest results of experiments carried out in space are mentioned in the book, that the latest pictures from space are in the book, and that “hundreds” of scientists have taken part in producing the book, most reviewers would want this book for their children.

6. **Laboratory Activities and Suggested Home Activities:** Most suggested activities were good ones and appropriate, but lacked the necessary follow-up for testing what had been learned from the experience. The theory or principle being tested was not obvious. During the course of this effort, we came across quite a few activity books that suffered in the same way – good experiments, but answers to “Why did we do it?” and “What does it illustrate?” go unanswered. Students come through school with a strong dose of mystical thinking. They believe that everything is possible. There are no bounds to what can be accomplished. Science says, “No!” There are bounds and science adds to our knowledge by showing what can’t be.

7. **Exercises to Test Understanding:** For the most part these were trivial from a physical science perspective. If one is trying to get answers from nature, one does experiments. One does not read a section of a text and then get quiz questions that only require remembering what was read. Granted some of that is appropriate, but too much gives the student the wrong idea about what science is

about. Science is not history or social studies. It's different, and these exercises typically do not emphasize that.

8. **Resource Suggestions:** Most books gave quite a few references to resource material for the teacher and the student. Teachers could get materials lists and suppliers from addenda to the texts. Usually this material was included in the Teacher's Edition of the student text. A couple had a tremendous amount of material coming close to providing a course for the teacher in teaching techniques, highlights of the various philosophies used in preparing the text, and several course outlines for the slowest students to the most gifted. The reviews mention some of these.

Suggestions for Middle School Teachers

1. As soon as you know what text has been chosen for you form a network with several other teachers of the same course in your area and make contact with a nearby expert in physics or chemistry or geology or biology. E-mail is a great medium for informal discussion and as a means of getting quick answers to questions. Search the web for relevant sites, especially the publisher's site. It may not be up-to-date, but it could be helpful.

2. If you haven't taken discipline-based courses in a subject area, say physics, contact the American Association of Physics Teachers (each subject area has a national organization that can direct you to local affiliates) and find out how they can help you. The AAPT publishes *Powerful Ideas in Physical Science* that contains some excellent material in the "less is more" format that you can immediately introduce in your class after you have worked your way through. Each unit begins with a list of common misconceptions that students (and adults!) have about that particular area of physics. Get your network to put together a bibliography of sources found useful in their teaching.

3. Ginn and Company published the Ginn Science Program elementary school in 1973 by Isaac Asimov and Roy A. Gallant. If you can find copies (many volumes), get them! Clifford E. Swartz, then Director of the National Science Foundation Workshop on Elementary School Science by a Quantitative Approach, wrote the three volume *Measure and Find Out: A Quantitative*

Approach to Science published by Scott, Foresman and Company in 1969. These books have what is missing from most of the books reviewed in this report. Holt, Rinehart and Winston published Project Physics in 1970 for 9th grade, but if you have never studied physics before, this is excellent and the teacher 's guides and readers will help you learn material directly applicable to your classroom. The National Science Foundation spent millions of dollars on several programs designed for the elementary schools in the 1960s. All this material is now contained with references to the National Science Education Standards on a CD from The Learning Team, called "The Enhanced Science Helper". The 2nd edition of Essentials of Elementary Science by Dobey, Beichner, and Raimondi is available in paperback from Allyn and Bacon. The Best of WonderScience from Delmar Publishers by way of the American Chemical Society has over 400 hands-on elementary science activities. Science Experiences for the Early Childhood Years 2nd edition by Jean Harlan and published by Merrill gets good marks from several elementary school teachers for the very early grades.

4. Subscribe to "The Textbook Letter" at tfl@textbookleague.org.
5. Take advantage of workshops appropriate to your course offered by the various discipline based societies – they are the next best bet to taking a course.
6. Contact John L. Hubisz at Hubisz@unity.ncsu.edu for further information.

Some Suggestions for Authors and Publishers

There were many scientists (mostly physicists) involved in this project, some formally and others informally. The following suggestions come out of their comments and reports and are in no special order.

1. Vocabulary must be familiar to ALMOST ALL middle school students especially those in the inner-cities whose relatives, parents, and neighbors have a limited command of English, those who are not in the upper 50% of their classes, and those who may have heard the words "mass", "volume", and "density", but are not exactly sure what they mean in the scientific sense. That is, they may still associate mass with church services, volume with a control on a transistor radio,

and density with a dense fog. Do not assume that students know the difference between mass and weight or that they know how to obtain the "mass" of an object using a spring scale or balance that they have always used to "weigh" things or that they know the scientific meaning of words such as "displace".

2. The format and the illustrations should be attractive so the student will not be turned off when he or she first turns to the assigned pages for reading or a homework assignment. They should not be overly "busy."
3. Include several interesting activities, most of which can be performed with simple, readily available apparatus, in a relatively short time. Making measurements and reporting the results should be emphasized.
4. Include homework assignments that require some thinking rather than pure memorization.
5. Attach a quiz with probing questions to help assure the teacher that the students have mastered the science concepts that have been included in your material; and, of course, be sure to supply meaningful answers that will help an average middle school teacher who has an inadequate science background.
6. For each illustration that you include, be sure to give adequate instructions to the photographer or technical drawing artist regarding colors, background, relative sizes and positions of key items. Do not assume that the photographer or artist has a good science background or is able to obtain a copy of the text material that is on the same page as his or her illustration. Make sure that the instructions to the illustrator are so clear that it will not be necessary to have him or her redo the illustration over and over again until it is perfect.
7. Be absolutely sure that your textbook material meets published national "standards" as well as those for each locality and state where these middle school books are to be used.
8. And, of course, strive for perfection and zero errors to avoid being exposed by

professional book reviewers and others who have never tried to write middle school materials themselves.

You see the task is not an easy one. Some of these notes are “tongue in cheek.” But note that good materials are out there and have been tested, but it is more than just being available. We have got to be more active in our schools so as to bring these materials to the attention of the teachers and administrators if they are going to be used. We also have to point out that the available textbooks are impossible tools to effect a change.

If a Decision Has to be Made

If I (JLH) were a principal having to make a decision about what textbooks to make available for my Middle School students, I would first realize that I must choose a book. The training of most Middle School teachers is simply not sufficient to trust that they can teach a course at this level without a text. Our limited look at teacher-generated materials convinces us that such efforts result in very bad material. Experience shows that some students will gain a lot from the text by themselves. My directive to my teachers would be to encourage or require that they forge links with other teachers in the same situation as well as experts in the field to be kept aware of problems and mistakes in the text, as well as to help each other over the rough spots. Publishers have already begun to respond to our criticisms and those of others by placing known errors on their web pages. We have many more to add and will be setting up a web page as a continuation of this project.

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The Textbooks

*Addison-Wesley Science Insights: Exploring Matter and Energy M. DiSpezio, M. Linner-Luebe, M. Lisowski, G. Skoog, and B. Sparks (1996)

*Carolina Academic Press Integrated Science (2000) 3 Volumes for 6th, 7th, & 8th Grades (1995) (1990)

The Center for Applied Research in Education Ready-to-Use Physical Science Activities for Grades 5-12 Mark J. Handwerker, Ph.D. (1999)

Delmar Publishers The Best of WonderScience (1997)

*Glencoe/McGraw-Hill Science Interactions Course 1 - 3 (1998)

*Glencoe/McGraw-Hill Glencoe Physical Science Charles W. McLaughlin and Marilyn Thompson (1999)

*Harcourt Brace & Company Science AnyTime (1995) 6th Grade

*Holt, Rinehart and Winston/Harcourt Brace Jovanovich Science Plus: Technology and Society (1993)

Holt, Rinehart and Winston Holt Physical Science (1994) and Teacher Resources Units 1-6

LeBel, J. M. Enterprises Integrated Science Two Books Alan Fraser, Ian Gilchrist, Tony Partridge, Harry Herzer III, and Bruce Hemphill (1994)

*Merrill Publishing Company Focus on Physical Science (1989) (1987) (1984) (1981) (1977) (1974) (1969)

Merrill Publishing Company Science Experiences for the Early Childhood Years Second Edition Jean Harlan (1980) (1976)

*Prentice-Hall Science Explorer Volumes A-O (2000)

*Prentice-Hall Exploring Physical Science Second Edition (1997) (1995)

*Prentice-Hall Prentice-Hall Science (1994) (1993) 6 Volumes

*Scott, Foresman and Company Discover Science (1991)

Scott, Foresman and Company Measure and Find Out: A Quantitative Approach to Science Three Books Clifford Swartz (1969)

*South-Western Educational Publishing Science Links (1998) Volumes 1-14

Steck-Vaughn The Wonders of Science: Matter, Motion, and Machines Joan S. Gottlieb (1990)

* Looked at in detail for this report