SCIENCE TEXTBOOK ACCURACY REVIEW FORM
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ACCURACY REPORT

This series of texts is uniformly good. The text discusses several topics outside my area of expertise and my review of those chapters was far less competent than I would like. I did refer to additional sources when possible.

I found no errors in the series that I would categorize as "egregious" and, given the vast coverage of these books, much of what I say below is almost quibbling. I was very surprised at how little I read that I thought necessary to comment on; as you will see below, there are literally very few pages on which I identified specific items deserving to be singled out. This should not be taken to mean that there are no topics that I and a significant fraction of practicing scientists and science educators would present somewhat differently, but, in many of those cases, I cannot present a strong argument that the approach used is wrong or even marginally unacceptable. It is just different. More often I was conflicted not by an error of commission, but more one of omission or of a simplification that, though necessary, one I would have done differently.

Science Explorer Grade 8 (0-13-069933-0, Teacher's Edition)

Page 12 - I disagree with the definition of theory as a "well tested concept," a phrase that makes theories seem to be much more narrow than they actually are. Theories are very broad and, as the book correctly states, explain a "wide range of observations." However, the term "concept" seems confining and limiting, making one think more of a hypothesis than a theory. Theories are built upon many well tested hypotheses, and therefore encompass many concepts and a very broad range of phenomena.
Publisher agrees to change the term *concept* to the term *idea* on p. 12 and p. 837.

Page 220, Paragraph 3 - An element "is . . . composed of a single kind of atom." I regard this as an oversimplification that may lead students to be confused later on in their educations when they learn that an element may be composed of several different kinds of atoms - isotopes. Isotopes are different kinds of atoms of an element that are almost identical in several important aspects, such as atomic number and chemical reactivity and macroscopic physical properties (such as the element's melting point), but different in others, such as mass and number of neutrons.
No change. The statement is not erroneous. Isotopes are different *forms* of the atoms, but are still atoms of the same element.

Page 220, Background "Box" at bottom of page - Though Paragraph 3 correctly ends with the statement that "almost all pure elements are metals," the list of seven minerals that appears as the last item in this "Background" contains three non metals (nearly half of the list) and two of the minerals are the same element: diamond and graphite are both carbon. Not a serious error, but one requiring comment.
Publisher agrees to replace "graphite" and "diamond" with "carbon."

Page 229, first line in Top Paragraph - "heat changed carbon atoms into the hardest known substance-diamond." This is seriously misleading because students and naive teachers could easily misinterpret this to mean that the carbon atoms themselves physically changed in forming the diamond rather than rearranged (made different bonds) to do so.
No change. The statement is not erroneous.

Page 281, Paragraph 2 - The comment, "it's the heat in your hand that moves . . . " is a misstatement that results from the confusion many have about heat, temperature, thermal energy, etc. Nothing has heat in it. Heat is thermal energy in transit from one body to another; it exists only "in transit." The statement should read that "it's the thermal energy in your hand that moves . . . "
Publisher agrees to change from "heat in your hand" to "heat moving from your hand."

Page 457, Paragraph 3 - The statement that "When all the atoms in a particular type of matter are the same, the matter is an element" repeats the serious error first seen on Page 220. All the atoms of an element are not the same; atoms of an element are very similar, differing only in mass, caused by a difference in the number of

neutrons the atoms contain. Isotopes of an element have virtually identical chemical and physical properties and are extremely difficult to separate from one another.
Publisher agrees to change the sentence to read: "When all the atoms in a particular type of matter are the same kind of atom, the matter is an element."

Page 506, Background Box - The authors wrote ". . . dissolved carbon dioxide and other compounds of natural origin that form weak acid solutions." This is a moderately serious misstatement that will, or at least could, confuse teachers. I think the authors mean to say "weakly acidic," a result of the relatively low concentration of hydrogen ions produced when relatively limited amounts of the corresponding components of the air dissolve. The guiding principle is correctly discussed on page 782 (see below), but then the term is again misused on page 783. The sulfur and nitrogen oxides in our air that dissolve in water produce strong acids, sulfuric and nitric, respectively. The carbon dioxide forms a weak acid, carbonic.
Publisher agrees to change sentence to read:" Ordinary rainwater contains dissolved carbon dioxide and other compounds of natural origin that form acidic solutions."

Page 758 - The discussion of crystals leaves out an important category, molecular crystals. Students are familiar with rock candy, a crystal consisting of molecules of sugar (sucrose). It is hard to categorize this omission as "serious," but it should not have happened.
No change. A discussion of all the different crystal solid types is beyond the scope of a middle grades program.

Page 782, Paragraph 1 - The authors correctly state that the strength of an acid "refers to how well an acid . . . produces ions in water" and correctly describes the process. Then however, on
Page 783, Paragraph 3 - the authors add the words strong and weak parenthetically and they do so incorrectly. A "concentrated (strong) solution of acetic acid" is NOT strong and a "dilute (weak) solution of hydrochloric acid" is not weak, though the solutions are "strongly acidic" and "weakly acidic," respectively. Acetic acid IS ALWAYS CLASSIFIED AS WEAK no matter how much of it is dissolved in solution and hydrochloric acid is ALWAYS CLASSIFIED AS STRONG, no matter how little of it is dissolved in solution. The terms "strongly acidic" and "weakly acidic" appropriately refer to the relative concentrations of hydrogen ions in the solutions and not to the strong or weak nature of the acids themselves.
No change. The terms weak and strong on p. 783 clearly describe and help students understand the meanings of two potentially unknown words, *concentrated* and *dilute* and in no way relate to the strength of the acids.

Science Explorer Grade 7 (0-13-069932-2, Teacher's Edition)
Prior to Page 286, I found little that I could identify as seriously in error or as a typo, but much of this is outside my area of expertise in the Physical Sciences.

Page 286, Paragraph 5 - There is much evidence that there are five basic tastes, rather than "only four main kinds of taste buds-sweet, sour salty and bitter." There is general agreement that the fifth is a taste sensitive to the amino acid glutamate and that it manifests itself in our afinity for meat,seafood and aged cheeses. This fifth "taste" was identified nearly a century ago, but is just now beginning to work its way into "conventional wisdom," so I do not think its omission is a serious error.
No change. Publisher considers including a taste for glutamate to be beyond the scope of the middle school curriculum.

Page 341, Paragraph 2 - The authors warn students that "Water vapor is invisible - it is not the same thing as steam, which is made up of tiny droplets of liquid water." This is not correct. One may argue that steam is water vapor produced by boiling water and water vapor is produced by any means by which it is produced, but steam is water vapor, not the visible cloud that is often called "steam." In reality, one cannot see steam. If one looks at the spout of a tea kettle when boiling water, the small gap of invisible gas between the end of the spout and the beginning of the visible cloud of water is the place where one finds the steam. This is an error.
Publisher agrees to change the sentence to read: "Water vapor is invisible"

Page 347, Paragraph 1 - The paragraph ends with the sentence "Acid rain is sometimes strong enough to damage the surfaces of buildings and statues." This ability to do damage is not the property we mean when we refer to the strength of an acid (or base), which refers to the relative ability of an acid to produce hydrogen ions in aqueous solution. The correct term to use here is "corrosive" rather than "strong." This is a misuse of the term "strong."
No change. Publisher considers the use of the term *strong* appropriate in its context and comprehensible to middle grade students who lack the chemical knowledge to understand the process of ionization.

Pages 352-354. This discussion is typical of an inappropriate focus when discussing the pressure of gases, the atmosphere in this case. Paragraph 1 on Page 352 correctly states that "Air pressure decreases as altitude increases. As air pressure decreases, so does density." However, this implies that it is the decreasing air pressure that causes the decrease in density. It is the other way around. The air pressure decreases because the air's density decreases. In Paragraph 2 on Page 354, it says "As air pressure decreases, the density of the air decreases. So density decreases as altitude increases, . . . " Again, this looks like the density of the air is a function of the air pressure, but it is the other way around.
No change. A causal relationship is neither implied nor stated in either of the two referenced locations.

Page 366, Paragraph 2 - I have never heard anyone refer to the wavelength of electromagnetic radiation as the distance between wave. This is a misstatement.
Publisher agrees to change statement to read: "Electromagnetic waves are classified according to wavelength, or the distance between two corresponding parts of a wave."

Page 480, Margin Note "Addressing Naive Conceptions" - In this note to the teacher, we once again see the confusion created by the authors because of their insistence that all the particles (atoms) making up an element are the same. As I wrote before, isotopes are different from one another, so an element, which is one substance, may be made up of different particles, depending on which element it is [some elements exist as only one nuclide (or "isotope")].
No change. A discussion of isotopes in an introductory chapter about matter is not appropriate because students are not yet aware of how an atom is composed.

Page 494, Paragraph 1 - A minor error when the authors write that "A molecule is a group of atoms that are joined together and act as a single unit." The same may be said of a polyatomic ion. The key to differentiate a molecule from a polyatomic ion is that a molecule is electrically (or, more correctly, electrostatically, neutral.
No change. The statement is not erroneous. Polyatomic ions are discussed and defined in the Grade 8 curriculum.

Page 499, Step 8 in "Isolating Copper" - Potentially, and only potentially, dangerous. I would not instruct the students to "Bring [their] face[s] close to the jar" before gently waving their hand towards their noses. They should keep their faces a safe distance away from the jar while the air above the jar is wafted in their direction.
No change. The students' waving hand will prevent them from getting too close to the jar. In Appendix A (#30), students are instructed how to test for odors.

Page 500, Topmost Left Hand Margin Note - It is incorrect to refer to the formula for diatomic oxygen (O_2) as the symbol for oxygen. The symbol for oxygen is O. O_2 is the fomula for molecular (or normal) oxygen. The authors correctly use the term formula in the same note when they suggest asking the student to write the formula for carbon dioxide, CO_2.
Publisher will delete the subscript associated with the symbol for oxygen.

Page 528, Paragraph 4 - Once again, the authors confuse steam with clouds of water. We do not see "steam . . . above a boiling kettle . . ." We see clouds. The steam, like the water vapor (which it is) described in the paragraph, is invisible.
Publisher will correct the SE page to read: "The white cloud you see" instead of "the steam you see" in paragraph 4, sentence 3, and delete the words "or steam" from sentence 4.

Page 544, Paragraph 3 - Minor error in that it says "Some iron atoms have a mass of 55, others a mass of 56, and still others a mass of 57." This is correct as far as it goes, but the masses of these atoms are not whole numbers. The real masses are approximately 55, approximately 56 and approximately 57. The way this is stated is misleading. Here, also, the authors introduce different types of atoms of an element, but they do not make the effort to point out how this modifies what they say earlier in the text about all atoms of an element being the same.

No change. Publisher considers that in context of the discussion on the *average* mass of an element's atoms, the statement is appropriate.

Page 547, Paragraphs 1 and 2 - The discussion of valence electrons is somewhat misleading and is only applicable to the elements in Groups 1, 2 and 13-17. Not all electrons "that are involved in transfer or sharing" are valence electrons as stated in Paragraph 1. This is particularly true of the transition metals, though less so for the representative elements. It is also not true, as stated in Paragraph 2, that it is the "number of valence electrons [that] determines whether the element gives up, shares, or accepts electrons." However, it is true that the number of valence electrons correlates with these processes. This statement makes it look like the number of valence electrons is the cause of the above, a very common way to misstate the situation.
No change. It is beyond the scope of the middle school curriculum to discuss bonding in transition metals. Publisher considers the explanation for whether an element "gives up, shares, or accepts electrons" is appropriate for a middle school student.

Page 560, Background Box at the bottom of the page - The first paragraph here states that the chemical properties of allotropes of the same element differ. This is not really true. For example, both graphite and diamond eventually make carbon dioxide when exposed to free oxygen. However, the rates at which chemical reactions take place may be very different for different allotropes of the same element. For example, ozone (O3) reacts much faster (much more readily) than normal diatomic oxygen does, even if the ultimate product(s) of the reaction is/are the same.
No change. Publisher refers Reviewer to the following sources:

The International Encyclopedia of Science and Technology. New York: Oxford University Press, 1999, p. 12.

Van Nostrand's Scientific Encyclopedia. 8th ed. New York: Van Nostrand Reinhold, 1995, v. 1, p. 624.

Page 609, Paragraph 1 and the discussion that follows - The authors do not make clear what a double or triple bond is or why they are different than single bonds. As a matter of fact, the authors do not really make clear anywhere that the sharing of a pair of electrons is a single bond. This would allow them to describe a double bond as the sharing by two atoms of two pairs of electrons and a triple bond as the sharing of three pairs of electrons. While this is truly a simplification of great magnitude, it would serve the students very well.
No change. Publisher considers the discussion of bonding appropriate for the scope of this curriculum. Atomic bonding, including double bonding, is discussed in more detail in the Grade 8 text.

Science Explorer Grade 6 (0-13-069919-5, Student Edition)
Prior to Page 117, I found nothing that I could identify as seriously in error or as a typo, but, as in the above text, much of this is outside my area of expertise in the

Physical Sciences. I think the text is remarkably good for its intended sixth grade audience and I cannot even quibble with its simplifications; they are of high quality.

Page 117, Paragraph 4 - Applying the term concept to a theory is too narrow in that a theory may be built upon and involve many concepts. [This is similar to the concern I expressed in my opening paragraph of specific remarks above regarding the Grade 8 text and what appears beginning on page 12 of that book.)
Publisher agrees with Reviewer and will replace the word *concept* with the word *idea* on p. 117 and p. 630.

Page 444, Paragraph 4 - I recognize that the text book is focused on the International System of units, but this is the first place I have seen where specific heat is expressed as the energy needed to raise the temperature of one kilogram of a substance by 1 kelvin. I have always used this in reference to 1 gram and several new texts I have checked alway use the term in reference to 1 gram of material rather than one kilogram. I was unable to check with the governing body for these things, IUPAC, to see if the new reference point is one kilogram. For almost every situation, using the term "specific" refers to the extent of a property when one gram of matter is involved.
No change. Although several variations are used, the Publisher is using Table 3a. SI derived units with special names and symbols, including the radian and steradianon. CRC Handbook of Chemistry and Physics: A Ready-Reference Book of Chemical and Physical Data. 82nd ed. CRC Press, 2001, p. 1-26. as a source.

Page 451, Paragraph 2 - The wording of this paragraph can be very confusing to a neophyte. The book overall makes it clear that thermal energy added to an object either will cause the temperature of that object to increase or it will cause the object to undergo a change of state. That is also clear from the graph on Page 451, Figure 14. However, Paragraph 2 opens with "Matter will change from one state to another if thermal energy is absorbed or released," as if it could not simply change in temperature as thermal energy is absorbed or released; the effect is not limited to changes of state. It would read better as "Matter will either change from one state to another or change temperature as thermal energy is absorbed or released." There is no temperature change as the change of state occurs, but, when dealing with pure substances, there is also no change of state as a temperature change occurs.
No change. Publisher considers the statement in the context of the phase change discussion to be adequate and not impede student learning.

Page 468, Paragraph 4 (continued as this paragraph continues onto Page 469) - I believe it is a serious error to use the term "orbiting" when referring to the electrons that exist on an atom outside of the atomic nucleus. The "motion" of electrons surrounding an atomic nucleus is random within the orbitals they occupy, properly described only in terms of probability. There is none of the predictability that the term "orbit" implies. We cannot tell at any instant where an electron is, if we could, we could not say how it got to where it is, and we cannot say where it is

going to go. If students think electrons orbiting a nucleus is similar to planets orbiting a star, they will have a very wrong picture of how electrons exist around the nucleus. This is a serious misconception, one of which it is very difficult to disabuse students at the introductory college level.
Publisher agrees to omit the use of the term "orbiting" on p. 468 and p. 625, and change statement to read: "In the area surrounding the nucleus are other tiny particles that carry a negative charge."

This report was edited to assure focus on the established purpose of identifying errors of fact.