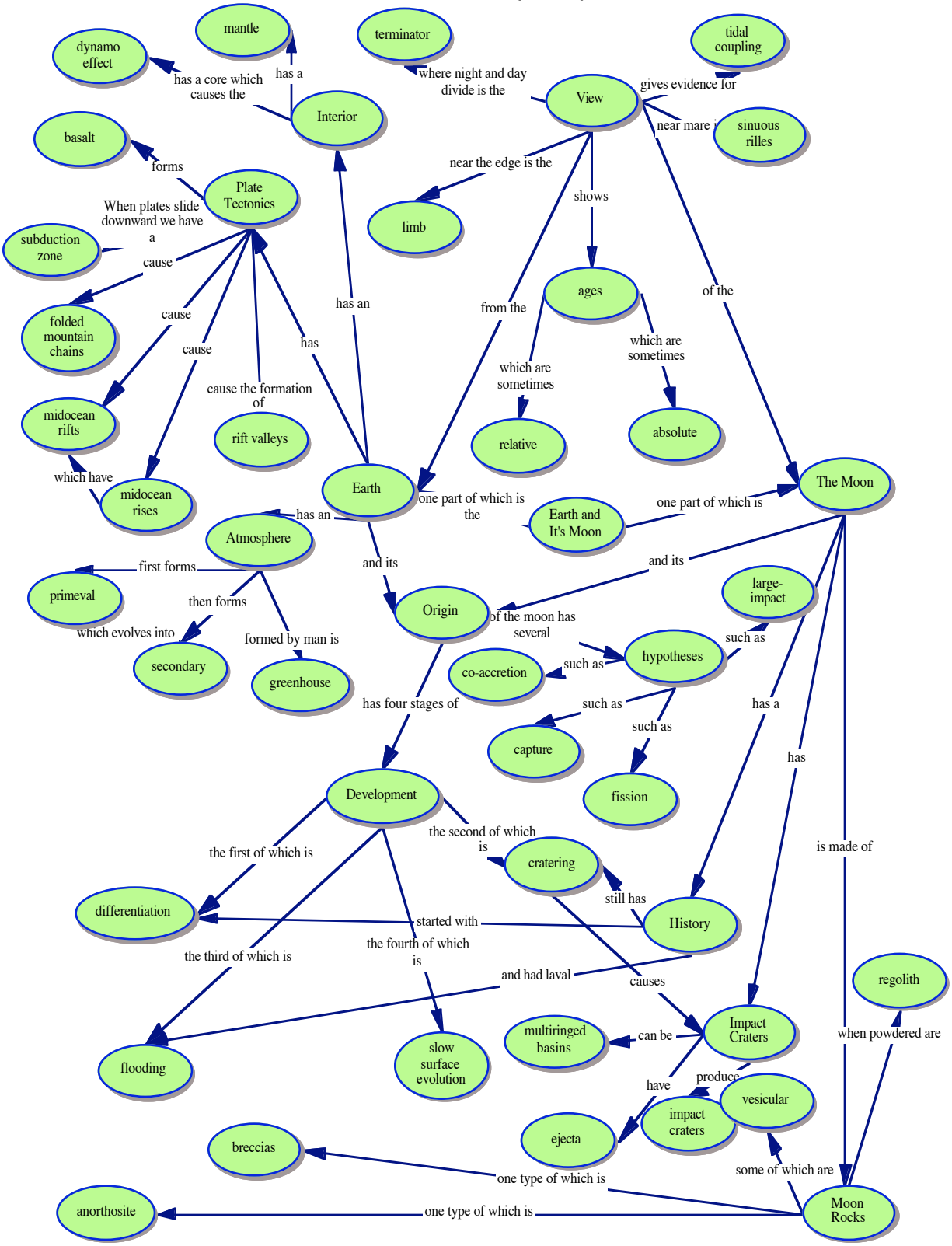
Analysis of Michael A. Seeds' 2001 textbook Astronomy: The Solar System and Beyond, 2nd Edition for use in 8th Grade Science

Part 1: Readability Form

Overall Grade Level Average: 9.0

Chapter	Earth's Interior	Plate Tectonics	Energy	History of the Moon	Average of the 4 Sections
Number of syllables	**149**	**159**	**154**	**145**	**151.75**
Number of sentences	**7**	**6**	**5**	**5**	**5.75**
Grade Level Average	**8**	**10**	**10**	**9**	just on the 9th grade side of the 8/ 9 line

Part 2: Concept Map



Earth and It's Moon[1]

I. Earth
  A. Interior
    1. dynamo effect
    2. mantle
  B. Plate Tectonics
    1. mid ocean rises
    2. subduction zone
    3. rift valleys
    4. folded mountain chains
    5. mid ocean rifts
    6. basalt
  C. Atmosphere
    1. primeval
    2. secondary
    3. greenhouse
  D. Origin
    1. Development
      a. differentiation
      b. flooding
      c. cratering
        (1) Impact Craters
          (a) multi ringed basins
          (b) ejecta
          (c) impact craters
      d. slow surface evolution
    2. hypotheses
      a. fission
      b. co-accretion
      c. capture
      d. large-impact

II. The Moon
  A. Moon Rocks
    1. regolith
    2. anorthosite
    3. breccias
    4. vesicular
  B. History
  C. View
    I. tidal coupling
    II. terminator
    III. limb
    IV. sinuous rilles
    V. ages
      A. relative
      B. absolute

[1] Here's the outline Inspiration produces from my concept map. One can see some flaws in the software when one compares.

Part 3: Completion of the Text Analysis Form[2]

Pages	Text Structures/ Organizational Patterns	Key Concepts	Text features	Questions
many many many	Primary Pattern: Object-Creation Justification: The primary pattern is object-creation. We start each section with an object (Earth or the Moon), and that go through its creation and how different layers were created as a result of processes undergone.	1. Creation Process of the Earth & Moon Subordinate Concepts • Cratering • Types of Rock • Plate Tectonics	Type: Outlined subsections Explain the connection to Key Concept(s) It is nice to have an outline of the chapter to see how different concepts fit into the big picture. The way the sections make a natural outline helps the student see the big picture.	Classification of Questions (Classify each question using the A&K Taxonomy Table. Write the question and label it.)
123-4 134-5 141 many 124	Subordinate Pattern (1): Definition Justification: This is seen in several subsections. In the "Four Stages of Planetary Development" section each stage is stated and then described. In the "Moon Rocks" section the descriptions of the rock are accompanied by the process which created them (our primary pattern).	2. 4 Stages of Creation Subordinate Concepts • differentiation • cratering • flooding • surface evolution	Type: Bold Words Explain the connection to Key Concept(s) The bold and italicized words guide the reader to important new concepts and new vocabulary. On pages 123-4, they make an outline of the subsection. Same for the moon rock section on page 135.	Embedded 1) We expect that Earth differentiated, but what evidence do we have to tell us what the interior of Earth is really like? Factual Knowledge Understanding / Exemplifying

[2] I started highlighting questions in blue and then saw you wanted them highlighted in different colors. I put yellow stars next to the blue questions I used. Sorry about that.

Pages	Text Structures/ Organizational Patterns	Key Concepts	Text features	Questions
129 139 141 many 139	Subordinate Pattern (2): Present-Critique Justification: Both in the origin of the moon section and the critical inquiry sections they present information and then look for evidence.	3. Plate Tectonics Subordinate Concepts • rocky crust • plates • mid ocean rifts • molten core • dynamo	Type: Figures Explain the connection to Key Concept(s) Figures, such as 6-12 on page 132, demonstrate concepts such as cratering.	2) Where did Earth get such a large satellite? Concept Analyze/ Attributing
141 124 129 139	Subordinate Pattern (3): Justification:	4. Atmosphere Subordinate Concepts • primeval • secondary • greenhouse	Type: Data Files Explain the connection to Key Concept(s) These give the student basic information on the planets being studied.	3) How did the moon form? Concept Understanding/ Explaining
141 141 140	Subordinate Pattern (4): Justification:	5. Moon Rocks Subordinate Concepts • basalts • breccias • vesicular • anorthosite • regolith • from lava flows	Type: Summary Explain the connection to Key Concept(s) The end of the chapter summary reviews the key concepts	Critical Inquiry 4) If the moon was intensely cratered by the heavy bombardment and then formed great lava plains, why didn't the same thing happen on Earth? Concept Understanding/ Inferring

Pages	TS/OP	Key Concepts	Text features	Questions
133 139 135 133 140		6. Explaining things Scientifically Subordinate Concepts • Hypotheses • Theories • Evidence	Type: Window on Science Explain the connection to Key Concept(s) Window 6-1 directly relates to this idea of hypothesizing and finding evidence.	5) What kind of surface features would you find, and what kinds of rocks would you pick up? The first part of the question is remembering (recalling) facts. The second part is creating (planning) facts.
139 129 140 141		7. Lunar Formation Subordinate Concepts • Old Hypotheses • Current Hypotheses	Type: Critical Inquiry Explain the connection to Key Concept(s) The one on page 129 is directly addressing the concept of evidence.	Review Questions 6) What are the four stages in Earth's development? Fact Remembering/ Recalling

Pages	Text features	Questions
141 142	Type: New Terms Explain the connection to Key Concept(s) Many of the key concepts have associated vocabulary.	7) What evidence would we expect to find on the moon if it had been subjected to plate tectonics? Concepts Understanding/Exemplifying
141-2 141	Type: End of Chapter Questions Explain the connection to Key Concept(s) These review the key concepts and force students to apply their new knowledge.	8) Why do we believe that Copernicus is a young crater? Facts -- Evaluating/Checking

Pages	Questions
142	Discussion Questions 9) If we visited a planet in another solar system and discovered oxygen in its atmosphere, what might we guess about its surface? Concept This is either explaining (but neither checking nor critiquing) or creating/generating.
142	10) If liquid water is rare on the surface of planets, then most terrestrial planets must have CO_2 rich atmospheres. Why? Facts -- Creating/Generating
142	Problems 11) About what percent of Earth's volume is occupied by its iron core? Facts -- Applying/Executing
142	12) If (the full moon) were orbiting Jupiter, how bright would it be? Facts -- Applying/Executing
142	13) Why do small worlds cool faster than large worlds? Facts -- Analyzing/Differentiating
142	Critical Inquiries for the Web 14) What would it be like to walk on the lunar surface? Concept -- Understanding/Explaining
142	15) What difference do you see between images from landings in highlands and maria? Facts -- Remembering/Recalling

	Remember Recognizing Recalling	Understand Inferring Exemplifying Classifying Inferring Comparing Explaining	Apply Executing Implementing	Analyze Differentiating Organizing Attributing	Evaluate Checking Critiquing	Create Generating Planning Producing
Factual •	15, 6, 5	1	12, 11	13	8	10, 5
Conceptual •		14, 7, 4, 3		2		9
Procedural •						
Metacognitive						

Part 4: Analysis by Category

Text Structures/Organizational Patterns

The primary organizational pattern (object-->creation) was easy to identify as many of the links in the concept map are causal (look for keywords such as forms, produces or causes, ordinal numbers, and actions such as powdered).

I find that this adds to the overall coherence of the text, because it focuses the readers attention at each new topic on how the subject of that section was formed.

This makes the chapter easier to understand because students know what they are looking for and what to get out of each section. I feel that for this to work best for the students, it needs to be pointed out by the teacher that this is the structure. I also wonder about the relative merits of following this organizational pattern in my course, vs. the benefits of using a different strategy from the book so that students for whom the object-->creation scheme doesn't work might have a different way to view things. Perhaps a combination of the two would be best: pointing out that the driving question for the chapter in the book is "How was _____ created?" while the driving question for my unit is "What implications follow from the structure of a planetary crust?" and that these are two ways get your (the student's) hands around the concepts that I need the student to understand.

Key Concepts

Most of the key concepts are identified explicitly in the summary. The two that are not are the overarching theme of planetary formation (although the four stages are listed there, I counted them as a separate, more specific key concept), and scientific thinking (which is given it's own window on science

section as well as two (one more than the other) critical inquiry sections). I feel that the explicit key concepts are given plenty of space in the text to allow students to understand them clearly. The implicit key concepts are also given plenty of play in the text. It is hard for a student not to see that the formation processes are a key concept. I am more concerned that a student might miss some of the scientific thinking/examining evidence skills which are also a key concept. They are located in two sidebars and only one section of the text (to any great extent at least). I feel a less diligent student may miss their importance.

Key concepts are developed in the readings, the summary, the figures, and questions at the end of the chapter. Each sub concept under the four stages is given a full paragraph on page 123, for instance. The very first review question on page 141 then asks the student to think back and reflect on that. They are also listed in the first paragraph of the summary on that same page, and shown in figure 6-1 on page 123. This particular text book is short on activities, but that's my job as teacher to supply.

Each subsection has one key concept with 3-4 subordinate concepts. The concepts are made concrete by the illustrations which make very clear what is going on. The concepts may be new to some students, so that increases the complexity somewhat, but I feel that the subsections are not too conceptually complex for my students.

Before reading the chapter, it would be helpful if the students had looked at the moon, knew about mountains, volcanoes, and earthquakes, and had some lived on our planet for some time. Most students should come in with enough basic knowledge to be

able to use this text to extend their knowledge effectively. Of course, after I have taught this unit, I will have a lot more to say about what my students did or didn't struggle with.

Text Features

The text features are key to making this a good textbook. The figures make abstract concepts concrete. The bold and italicized words serve to quickly identify important vocabulary to the student as well as as visual book markers to help students find a relevant passage quickly during a classroom discussion. The guidepost puts the chapter into context with the rest of the book while the outline layout puts each section into the big picture of the chapter for the student, and also serves as visual bookmarks in the same way as the bold and italicized words. The summary puts all the relevant information in one place. The questions at the end give the students a way to engage the text. The windows on science and data files give more information without interrupting the flow of the text. The critical inquiry sections prevent students from being passive recipients of knowledge as they are forced to see how scientists question their own conclusions. In conclusion, the varied text features are useful to the student and key to making this a good textbook.

The text features reinforce the key concepts in many ways. The explicit key concepts are listed in the outline layout, shown in the figures, summarized in the summary, and reviewed in the questions. I have dealt with the implicit ones in the key concepts section.

I find the outline, figures and summary most helpful. Other students may enjoy the questions, or if not enjoy them, at least find that they contribute to their understanding of the material presented. These are most helpful because they are the features

which reinforce the key concepts (see preceding paragraph).

Questions

You will find my question analysis form above in part 3 of this assignment.

I find that while the questions are fairly balanced along the cognitive dimension (with only a slight preference for understanding questions), they are not balanced along the knowledge dimension (see the question analysis form). This book doesn't deal with metacognitive knowledge at all, for one thing. There were several questions which I listed as factual which involved some calculations (for example question 12 in the text analysis form). The calculations are not a procedure I plan on teaching in the unit--it is prerequisite knowledge (I didn't list it above because it is only needed for the problems, not for understanding the text.)--so while it involves procedural knowledge, it doesn't involve procedural knowledge for this course. If you look at it this way, the chapter isn't really teaching procedures (although the critical thinking skills involved in analyzing evidence could be argued as a procedure).

Overall, I was impressed by the quality of the questions asked. The text has plenty of higher order thinking questions for students to ponder (see question analysis form, there should be an average of 2.5 questions per category, and there are 3 questions in the creation category). The factual questions often involved calculations requiring an understanding of the phenomena discussed. Questions are often salient to the discussion, such as "What evidence would we expect to find on the moon if it had been subjected to plate tectonics?," question #7 in the text analysis form. Even when they are less salient to the specifics of the chapter, they are always tying in the concepts in the chapter with the discussions in the

book as a whole. Question 12, for instance, relates our moon to those of Jupiter and explains in a way why Jupiter's moons can only be seen through a telescope while ours can be see with the naked eye: "If (the full moon) were orbiting Jupiter, how bright would it be?"

The questions are also scaffolding, but the teacher needs to be aware of this to point it out to the students. Questions 1, 5, and 6 build from each other. Question 1--"what percent of the Earth's volume is occupied by its core? by its crust?"--starts the exploration of volume vs. surface area (even though it is couched in terms of volume, the volume of the crust requires calculating the surface area first). Question 5--"What is the ratio of the volume of the moon to that of the Earth? What is the ratio of the masses different?"--starts looking at size ratios as things that can be different. This is an important concept: that "how much bigger is it?" can have many answers depending on what you are trying to do (build houses on it, fill a super sized drink cup, or smash it into something to change that thing's velocity). This brings us to the third question in the series--"Why do small worlds cool faster than large worlds? Compare surface area to volume."--which adds some extra scaffolding, but finally asks the question of how the difference in volume, as opposed to surface area, can change the structure of a world. I don't think my students would get the connection between these questions unless I specifically said, "Do problem 6. If you get stuck, try problems 1 and 5. They'll help you out."

Part 5: Conclusions

Is there any discrepancy between the results of the readability analysis and your synthesis of the information you included in the text analysis? Elaborate upon your response. Make sure to include examples from your analysis that support your opinion.

I'm not exactly sure what discrepancy you might be looking for here. I find this to be a well written text book which uses many text features to further a student's understanding. It has a readability analysis which is right on the border between 8th and 9th grades, but I am planning on using sections from it only at the end of the 8th grade year, so that is in line. I did notice that some sections were registering at the 10th grade reading level due to the sensitivity of the reading scale to the number of sentences especially. The difference in number of sentences is within the sampling error certainly (if I count from the end of the sentence rather than the beginning it changes the sentence count by 1). Further, the difference between the number of syllables per hundred words in the extremes is equivalent to using an *also* instead of an *and* every 10 words.

What important information in terms of where students may have comprehension problems is added by using the Text Analysis Form?

I feel that the Text Analysis Form and the Analysis by Category section that followed it were most helpful to me in that they helped me to find some "hidden" text features (such as the scaffolding of the questions) which I can point out to the students so they can use them. It also lets me see the kind of questions the book is asking and makes me more comfortable assigning questions out of this book than I would be out of just a random text book because of the higher order thinking skills they require.

The Text Analysis Form also helped me identify the types of calculations the book is requiring so that I can decide to either

help my students with them, or simply not assign them. (I'm not using the entire text in my student teaching, but I wanted to analyze it to judge whether I could use parts of it (especially this chapter) to supplement by unit.

Based on your analysis of the sections you selected, what types of reading/dispositional thinking routines would you have to use in order to avoid comprehension problems?

I would point out general text book reading skills, concentrating on the specific ones this text uses. If I assigned problems from the book I would look for how they were scaffolded and assign them together so that students would have easier problems available as they worked on harder ones. I would also make a big deal about evidence during lecture because that is an implicit key concept which could be skipped if students only read "the text."

Where specifically would the weakest readers have problems? Be specific by citing examples from the sections.

I'm not sure where the weakest reader would have problems. I think they would have problems in the areas they knew the least about, but that would vary from reader to reader. Perhaps paragraph 2 in column 1 of page 125 might be one such paragraph if the readers are unfamiliar with magnets and how they work.

What type of activity would you include to help the weakest readers better understand the information?

The best way I could help them understand better is to have demonstrations and discussions about what they don't understand in class. This involves a lot of informal assessment so that I know what they don't understand and can help them understand it.

In the case of the paragraph listed above, I might talk about the alternator in cars and do a demonstration of a homemade electromagnet.

References

Sebranek, P., Meyer, V., & Kemper, D. (1992). *Writers inc*. Burlington: Educational Publishing House.

Seeds, M. (2001). *Astronomy: The solar system and beyond.* Pacific Grove, CA: Brooks/Cole.