Exploring Creation with Earth Science Review

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The first two sections detail why anyone who has enjoyed Jeannie Fulbright's *Exploring Creation With…* books will probably not enjoy this book. The next two sections include the scientific errors that should give everyone pause when it comes to using this book. The final section just lists the things that are mystifying to me.

Clear Indications That This is a Different Author:

1. There are no "Creation Confirmation" sections. Fulbright always related what she was discussing to the creation model when it applied. As a result, she developed several arguments for young-earth creationism. There is nothing like that in this text.
2. This text does use narration (a Charlotte Mason technique) from time to time, but Fulbright used it much more frequently.
3. This is not anything close to a living book. The writing is conversational, but the author often talks down to the student, which Fulbright never did. In addition, Fulbright taught the science in story form and covered the subject in depth, so that her books are truly living. By contrast, this book is much more like a Usborne book. It is covered with pictures and lots of random facts, but there is no story.
4. The index is very poor. It is sparse, and many of the words in the index have no page numbers. They are listed, but the index doesn't tell you where to go.
5. There is no glossary. For a book that is very heavy on terms, that is very bad.
6. Few illustrations have captions, and many of them are hard to relate to what is being discussed. For example, on p. 33, there is an excellent long-exposure image of stars, showing the circles they make in the night sky as the earth rotates. It is in the section that discusses the earth's rotation, but the text never explains the picture properly. Thus, the students don't understand how the image shows the rotation of the earth. On p. 133, there is an illustration of an artesian aquifer. The author uses it to discuss aquifers but doesn't explain what "artesian" means. Sometimes, the illustrations contradict the text. On p. 185, for example, the illustration used to describe rainbows incorrectly makes it look like the rainbow appears between the viewer and the sun. The text properly says the viewer must be in between, with his or her back towards the sun.
7. The material is scattered and unconnected, and what the student is expected to grasp is incredibly simple. This book requires significantly less of the student than any of Fulbright's work.
8. There are times when scientific terms or ideas are mentioned and not explained. For example, on p. 87, metamorphosis is described using a butterfly and a caterpillar. If the student doesn't know about the lifecycle of a butterfly, he or she won't understand metamorphosis, because the lifecycle is not explained. The author assumes the student knows about it. She discusses how volcanic islands and coral reefs make an atoll, but not what a coral reef is. The term infrared is used on p. 192 with no explanation. On pp. 239-241, there is a table listing minerals and what they do. It is *filled* with scientific terms (like "metabolism" and "protein formation") that are not explained. Sometimes, the idea is mentioned and explained later. For example, the student is told that water expands when it freezes on p. 94, but the author doesn't explain what that means or the

fact that most substances don't do that. She doesn't get around to explaining these things until p. 119. On p. 119, she says a gas expands to fill its container, but she doesn't explain what that means until p. 143. The terms Summer Solstice and Winter Solstice are used on p. 133 but not explained until p. 162.

9. The author often tries to explain things too quickly, making confusing statements. On p. 127 she says, "The direction of the Earth's rotation is the same in the north and south. Therefore, hot air spreading north gets bent the same way as hot air spreading south. This starts the rotation in opposite directions." How does the same rotation of the earth and the same bend produce opposite rotation directions? It does, but I don't see how anyone could read that sentence and not be confused. It takes a lot more explanation than that!
10. There is no mention of the worldwide Flood. I cannot imagine Jeannie Fulbright writing an earth science text without mentioning the single most important event in both the geosphere's history and the hydrosphere's history! Even if you are an old-earther, you still need to discuss the Flood, specifically to indicate why you don't think it left a lasting impact on the geosphere.
11. There is *one* mention of fossils, and it consists of two sentences. Once again, I think Jeannie Fulbright would have discussed fossils, what they tell us of the earth's history, and how they support young-earth creationism.

<u>Inherently Old-Earth Assumptions</u>:

1. (p. 17) The discussion of the expanding universe says it appears like we are at the center of the universe because it has no geometry. Nearly every young-earth creationist cosmology has a geometry to the universe. We are not necessarily at the center, but the there is a geometry. If that is true, then unlike the book says, the universe won't always look like we are at the center, because at some point, we will be able to see the "edges" of the universe and be able to determine its geometry. Then, we will know whether or not we are at the center.
2. (p. 18) "Scientists currently believe that the unobservable universe probably looks like our observable universe." In fact, only those who believe in the Big Bang as a creation story believe that. Serious scientists understand that unlike the Big Bang assumes, the universe is not homogeneous. Thus, the unobservable universe is probably quite different from the observable universe.
3. (p. 72) "When the earth was formed, the heaviest materials sank into the core and the lightest materials came to the top." This is a serious scientific error as discussed in the section on serious scientific errors, but it is also based on the standard evolutionary view of earth forming through random aggregation of rocky materials from the sun's debris disk. No young-earth creationist would think this. Old-earth creationists and theistic evolutionists would have no problem with it.
4. (p. 85) "How does falling material make rock? It takes a long time and a lot of material." This is once again a common refrain among evolutionists and old-earthers, but it is false. Catastrophes produce sedimentary rock very quickly, as the floods following the eruption of Mount St. Helens clearly demonstrated.
5. (p. 98) "How long does it take to make soil? That depends on where you start. If we start with really big rocks and wait for them to break down through the weathering

process we studied, it can take thousands of years until they become the particles we know as sand, silt, and clay." This is the standard evolutionary/old-earth story, but it is not true. Soils can form rapidly as a result of catastrophic processes. Also, a large rock in a stream will produce silt and clay slowly, but lots of large rocks in the stream will produce silt and clay quickly. All of that silt and clay will get deposited by the stream. Thus, soils can form quickly even in non-catastrophic conditions. The author is essentially saying that sedimentary rocks take more time to form than we have on the young-earth timescale.

Serious Scientific Errors:

1. (p. 17) "The light is always traveling toward us faster than the objects are moving away. So why do we care that the universe is expanding if we can still see the lights in the night sky? Well, what we may never see would be the lights in the current unobservable universe that will always be too far away for their light to ever reach us." The first sentence is true. However, because it is true, the last sentence is false. Since the stars are moving away from us more slowly than their light is moving towards us, *all* stars will eventually be visible.
2. (p. 28) "The bigger something is, the more gravity it has; this will be important for Earth." Size is not related to an object's gravity. A neutron star, for example, has a diameter of about 20 kilometers, while the earth is much, much bigger, with a diameter of about 13,000 km. However, at equivalent distances, a neutron star has, at a minimum, *one million times* the gravity of the earth. What the author means is that the more mass an object has, the more gravity it has.
3. (p. 34) "Some planets rotate and some do not." *ALL* planets rotate. Physic requires it. Some rotate slowly, and some rotate quickly, but they all rotate because of inertia. There would have to be a significant amount of friction in space to keep a planet from rotating. We can confirm this in our solar system. All planets, dwarf planets, and moons rotate.
4. (p. 39 as an example) In the illustration of the earth's spheres, the Atmosphere is illustrated with clouds. However, clouds are a part of the hydrosphere, as the hydrosphere is defined as all parts of the earth that have water. This leads to a lot of confusion throughout the text.
5. (p. 47) "Detergent-like particles in our atmosphere continually scour the air and remove harmful gases." I have no idea what the author is talking about. Detergents work because they are polar on one end and nonpolar on another, which will have no effect in air. If the author is saying that there are particles in the air that remove pollutants, that's not true. There are particles that react with pollutants, but it doesn't remove them. It changes them into something else, and that something else is rarely less toxic than the original pollutant.
6. (p. 72) "When the earth was formed, the heaviest materials sank into the core and the lightest materials came to the top." This is 100% false. If it were true, the core would be uranium, as it is the heaviest material. In fact, the core is iron and nickel, which are lighter than many of the elements on the planet. The author probably means that *denser* materials sank, while less dense materials rose to the top, but even that's not completely true, because the materials of the planet had to be molten for this to occur. According to evolutionary storytelling (which is necessary if you are claiming the geosphere formed

this way), as the earth formed through accretion of debris in the sun's disk, it heated up. When it reached the melting point of iron (called the "iron catastrophe), a runaway process occurred that allowed the migration of materials the book discusses.

7. (p. 85) "Sediment is a solid material that falls to the bottom of a liquid." That is simply not true. Sediments can fall out of liquid, but they are also deposited by water, left by evaporation, made by wind, etc. Sediment is a naturally-occurring material that is broken down by processes of weathering and erosion, and is subsequently transported by the action of wind, water, or ice or by the force of gravity acting on the particles.
8. (p. 88) "The making of metamorphic rock is something you might study again in college. For now, just know that rocks can be changed with temperature, pressure, and chemical reactions. And where do we find these things? You're right if you thought about Earth's Mantle." This is false. Metamorphic rock is definitely not formed in the mantle. It is formed in the crust. Magma rises from the mantle to form *igneous* rock in the crust. Then, that igneous rock can become metamorphic rock, which happens only in the crust. Also, lots of high-school earth science courses discuss the details of metamorphic rock formation. Why does the author indicate the student will have to wait until college? Why does the author assume that the student will go to college?
9. (p. 94) The virtual activity on this page claims that an uncovered bottle full of water broke in the freezer because when the water froze, it expanded. This would only happen if the bottle was covered with a rigid lid. In the scenario shown, the ice would simply rise out of the bottle. The author claims that the water froze on the top first, and that produced a "lid" that prevented more ice from rising. However, that's not how it works. I use the fact that it rises out of the bottle in two separate experiments in my courses, and it always rises out of the bottle without breaking anything. I assume that the cracked bottle she shows in the activity cracked because of temperature changes. It most certainly didn't crack because of water's expansion.
10. (p. 116) Would you believe me if I told you that all water has a naturally blue color that gets bluer as you get more water? It's true." No, it's not. The author got this from a Wikipedia article that was not written by a knowledgeable scientist. Water can be *defined* as, "A tasteless odorless colorless liquid with the chemical formula H_2O." It *appears* blue when the conditions are right and you are looking from the right angle, because blue light is not easily absorbed by water. Thus, if you look at a body of water from above, the light that reaches your eyes must travel down into the water, reflect back up, and go to your eyes. That means you will see more blue light, making the water look like it is blue. In the picture on the page where this is being discussed (from the Wikipedia article), there is water in a white bucket. The water has a slight blue tinge, once again, because light had to travel through the water, reflect off the bottom or sides of the bucket, leave the water, and hit the camera. Blue light is more likely to do that than any other color, so it appears blue. However, that's not because water is blue. That's because of how the different wavelengths of visible light travel through water and how you are looking at the water.
11. (p. 142) The author tries to explain why the sky is blue but doesn't understand it. She is right that it depends on scattering, and blue light scatters better than the other colors. However, like water, she thinks it has something to do with amount: "Any scattering of the light in the air around you isn't enough to make things seem like they are blue." It has nothing to do with that. The sky is blue because when you look at any part of the sky

that doesn't contain the sun, the only way the sun's light can get to your eyes is to scatter off molecules in the air and then hit your eyes. Blue light scatters best, so the more you look away from the sun, the more you will see only light that scatters several times, and that's blue light. When you look right at the sun, you can see light coming directly from the sun, which is white. The sunsets are red and orange because once again, you are looking at the part of the sky that contains the sun, so you are seeing mostly light coming straight from the sun (or only doing a small amount of scattering). Since blue light scatters best, the blue light doesn't reach your eyes, making the part of the sky that contains the sun look red and orange.

12. (p. 144) "Pressure is like a force that pushes on things. It's not technically a real force, but you can think of it that way." Of course pressure is the result of a real force. The unit is pounds (a force) per square inch (area), and it is very real.
13. (p. 147) Activity 8.1 has the student put 15 pounds of something in a backpack and lift it with the straps bunched together. That's supposed to show the student what 15 pounds per square inch feels like. However, that doesn't work unless the student is holding on to only one square inch of strap, which would be hard to do. 15 pounds per square inch is much more pressure than the activity indicates.
14. (p. 151) The author presents the Coriolis force as a real force. She says, "The Coriolis force is due to the rotation of the Earth, and it forces winds going to the poles to turn east." Remember, she claimed pressure isn't a real force when it was. In this case, she is talking about something that isn't a real force as if it is a real force. The Coriolis force is better called the "Coriolis Effect." It doesn't exert a force. It is a consequence of the fact that things on the equator must move faster than things at the poles in order for the earth to rotate. As a result, things traveling in the air towards the poles are moving with the earth's rotation faster than the ground over which they are moving. As a result, they "outrun" the ground, curving in the direction of the earth's rotation (east).
15. (p. 155) "The Sun actually provides us too much energy, so the earth has to get rid of some energy or it will overheat. Getting rid of extra heat is something important our atmosphere does." This isn't true, and more importantly, it really confuses students who learn about the greenhouse effect, which traps energy before it leaves the earth. Without the greenhouse effect *retaining* energy and keeping it from escaping, the earth would be too frigid to support life. The author seems to be confused between the earth's energy budget and the atmosphere's energy budget. This is a very complex process that goes beyond the scope of this review. However, here is a good description of it: https://earthobservatory.nasa.gov/features/EnergyBalance.
16. (p. 191) Physicist Daniel Gabriel Fahrenheit defined 0 °F as what he thought was the coldest possible temperature. He then set 100 °F as the temperature of the human body." Fahrenheit knew there were colder temperatures than his 0. He just called it "extreme cold," since it was very uncomfortable. In fact, Fahrenheit defined the freezing point of water as 32 and human body temperature as 96. Since then, we have redefined the scale so that water freezes at 32 and boils at 212. That makes human body temperature 98.6.
17. (p. 238) In discussing algae blooms causing dead zones in the water, the author says, "The algae bloom uses up the oxygen left behind, and not enough oxygen is left for other plants and animals." The author is right that all photosynthetic organisms must use oxygen to burn the food they make through photosynthesis, but that's not what causes dead zones. Photosynthetic organisms make more food than they burn, so they always

produced more oxygen than they use. Algae blooms cause dead zones because algae die of "old age." Those dead organisms then fall to the bottom of the ocean, and bacteria decompose them, using up all the oxygen down there. So it's not their use of oxygen that causes the problem. It's the bacteria's use of oxygen in decomposing them. Also, an algae bloom can shade the photosynthetic organisms below, exacerbating the problem.

18. (p. 243) In discussing transpiration, the author says, "But plants suck up a lot more water than they need and must get rid of the rest." No. Transpiration happens because it pulls water up from the roots, according to the cohesion-tension model. It's not that the plant sucks up too much water. It's that transpiration *is used* to suck up the water.

Minor Scientific Errors:

1. (p. 20) "If you are ever outside on a really clear and dark night, you might be able to see part of our galaxy." You *always* see parts of our galaxy, since you see planets, the moon, and nearby stars, all of which are parts of our galaxy. I think the author means that on a clear, dark night, you can see one of the spiral arms of the galaxy, which appears as a thick "ribbon" of stars that crosses the night sky.
2. (pp. 21, 22 and others) In all the discussion of the solar system, the illustrations have the wrong scales for both size and distance. This is fine in principle, since the scale is hard to illustrate, but somewhere, the students should be told that the sun, for example, is much, much bigger relative to the planets than what any of the illustrations show.
3. (p. 29) "Your plant needs sunlight, water, air, and soil to survive." That's not true. Hydroponics is all about growing plants without soil. The author goes on to say, "Well, if you tied a string around your plant and hung it from a doorway with its roots exposed, it wouldn't live very long." However, that's a pretty good description of hydroponics. Plants *do not need soil*. They need water and specific minerals. Those can come from soil, but they can come from other sources as well. And, in fact, even without the minerals, the plant will live for a long time with access to only water.
4. (p. 30) "Even though they have a rocky core, the planets Mercury and Venus are too close to our sun and too hot to have life exist." The fact that they have a rocky core is not relevant. In fact, even the gas planets in our solar system have a rocky core. I think the author means that even thought the planets are terrestrial (as opposed to gaseous), they still can't support life.
5. (p. 30) "What about Mars…it is still on the edge of the habitable zone." That is very controversial. Most creationists would say it is not, because creationists put more stringent conditions on the habitable zone. You can also find a lot of secular scientists who say it is not in the habitable zone (see https://www.planetary.org/articles/what-is-the-habitable-zone, for example). Only a portion of scientists would agree with the author's statement.
6. (p. 46) "Stratosphere means "spreading out." No. French meteorologist Léon-Philippe Teisserenc de Bort (1855-1913) coined the term, and he says stratosphere means, "sphere of layers," which makes a lot more sense. Now…*part* of the word ("strat") comes from *stratus*, which is Latin for "a spreading out."
7. (p. 72) "If 2 oceanic plates diverge, the size of the ocean increases." That's not true. It depends on what happens on the other side of the plates. If subduction is happening as quickly as divergence, the ocean will not increase in size at all. Currently, divergence is

making the Atlantic Ocean bigger. However, that's because on the other side, the plates are moving, making the Pacific Ocean smaller.

8. (p. 82) "Remember that I told you that longer and warmer temperatures make larger crystals?" I am not sure what a "longer" temperature is, but the temperature itself has no effect on crystal size. The rate at which the temperature changes does. The slower the substance cools, the larger the crystals. This is mentioned correctly elsewhere in the text, which is why I list this as a minor error.
9. (p. 99) "Clay soil is a reddish soil." The color of clay soil depends on the contaminants in it. A lot of clay is reddish, because it is contaminated with iron that has oxidized. However, there is yellow clay soil, blue clay soil, and various mixtures of red, yellow, and blue.
10. (p. 105) "Glaciers are very large masses of compacted snow and ice." The best definition of a glacier involves motion: Oxford says a glacier is "A slowly moving mass or river of ice formed by the accumulation and compaction of snow on mountains or near the poles."
11. (p. 125) "A tsunami is a single large wave." It is not. As the NOAA says, "A tsunami is a series of waves caused by earthquakes or undersea volcanic eruptions." Even the illustration on the page shows it is a series of waves.
12. (p. 155) "When the cloud temperature is below the freezing point, the water vapor deposits into ice crystals, and it snows. Sometimes, the temperature gets warmer on the way down, and snow can turn into sleet." This isn't complete. If the temperature gets warmer on the way down, the snow melts, and it forms rain. If it gets colder further down, the liquid water can refreeze. That's what sleet is – rain or melted snow that encountered cold air and froze.
13. (p. 155) "How does hail form…First, it has to start snowing in the cloud." Not true. Hail usually starts off as rain that gets lifted by an updraft to a higher part of the cloud where it is cold enough to freeze. Hail can start as snow, but it must melt in the lower parts of the cloud before it can start to form hail.
14. (p. 179) In discussing charge buildup in a cloud the author says, "As this happens, the bottom of the cloud can get a charge." True, but the top of the cloud will get the opposite charge. The author makes it sound like there is only one place the cloud is charged.
15. (p. 192) "…astronomer Anders Celsius defined 0 °C as the freezing point of water and 100 °C as the boiling point of water." Actually, Celsius said it the other way around, because on his scale, higher numbers meant colder temperatures. This was in honor of Galileo, whose thermometer's reading increased with colder temperature. Once Celsius died, Carolus Linnaeus reversed it so that higher numbers meant hotter temperatures. So in the end, the author does give the right numbers for the Celsius scale, but she should not say that those were the definitions used by Celsius; he used the opposite definitions.
16. (p. 210) The author gives symbols for what she calls a "low pressure front" and a "high pressure front." However, they are the symbols for a cold front and a warm front. Now…a cold front usually has high pressure behind it, and a warm from usually has low-pressure behind it, but the weather terminology on weather maps is very clear – temperature, not pressure, is used to describe the fronts.
17. (p. 213) The illustration that is supposed to show levels of organization has two animals that represent a population: a male walrus and what *might* be a female walrus. If it is a female walrus, it is a bad drawing, because it looks too different from the male in terms of its markings. If it is something else (like a seal, which is what it looks like), then the

illustration is wrong, because a population consists of individuals from the same species. Figure captions would fix this problem, but they don't exist for most illustrations, including this one.

Things I do not understand:

1. Jeannie Fulbright is loved and has a great following. She has written seven books in this series, all of which are popular, especially among those who love Charlotte Mason's approach to education and the concept of "living books." Why in the world use another author now?
2. (p. 10) In a box labelled "worldview," the introduction says that the book "is written as a creation-based text." There is a "worldview" box at the beginning of every lesson, but few of them actually discuss anything related to a creation worldview. In addition, virtually nothing about creation is discussed throughout the text. There are Scripture verses aplenty, and many mentions of God, but nowhere is the creation model discussed or contrasted to any other model. This reads much like a secular text with various Scripture verses and mentions of God scattered throughout in order to "Christianize" it. Even the last lesson, entitled "God in Creation," doesn't mention God much and never talks about how He created. Instead, it mostly discusses the scientific method, ways that scientist care for the earth, etc.
3. (p. 10) Activity 1.2 is supposed to show the student that no matter where you are in the universe, it will always look like you are at the center, which is true, assuming the universe has no geometry, which is an inherently old-earth assumption. However, it tries to get the students to see that by having them go to the *center* of each room and looking around. Then, the students are supposed to understand that since they seemed to be at the center of each room, they will always think they are at the center of where they are. However, they *are* at the center of each room. If they went to the corner of each room, they wouldn't think they are at the center!
4. (p. 227&228) The discussion of food webs starts out with a discussion of food chains, which is common. However, the illustration is of a web. On the next page, there is an illustration of a food chain. Since she started with a food chain, the food chain illustration should come first and be with the part of the text that discusses a food chain. Also, on the food web illustration, a blue arrow goes from the sun to leaf litter, as if leaf litter uses the sun's energy. However, it doesn't, because leaf litter can't do photosynthesis.