

The Evolution of Life

Spring, 20xx
Geology 230:
Test # 1

Name: _____

Date: _____

Time Begun: _____ Time Ended: _____

RULES FOR ALL LECTURE TESTS

*Lynn S. Fichter
James Madison University*

- ☺ You have a several day period in which to take this test. You may take it any time during that several day period. The days available will be announced in lecture.
- ☹ You may not peek at these questions in any way until just at the moment you are ready to take the test.
- ☺ The test will probably take more than 50 minutes, but you must take the whole test in one sitting. Pit stops are allowed. There are no time limits.
- ☺ You must sit and work alone while taking the test.
- ☺ When you sit down to take the test you may have only the following items:
 - ☺ The test paper and scantron card.
 - ☺ Any writing instruments [rulers, colored pencils, etc.] you need to write your answers.
 - ☺ Any refreshments you require for the duration.
- ☹ Once you have taken the test you are expressly forbidden talk about it in any way, shape, or form with anyone else, except me, until everyone has finished taking the test.

HONOR: SCIENTIFIC AND PERSONAL

Science and honesty must go hand in hand. Science is the search for a true understanding of the universe, not what we wish it to be, or need it to be. But the universe is complex and for all our success science has had to struggle mightily to learn what it has. Dishonesty thus is very detrimental. Not only does it deliberately lead us down the wrong path, actions taken on the basis of that false knowledge can be deadly. Besides good ideas are hard enough to discover even when struggling honestly.

Personal dishonesty is also detrimental. Dishonesty in science, when discovered, destroys a career, and ruins a reputation. And dishonesty is always discovered because science's goal is to uncover false ideas.

Because each of you take this test individually, and without supervision, whether you cheat or are honest is your very personal and private responsibility. Not cheating means no notes, and not talking with anyone until everyone has finished the test - following the spirit of the law rather than just the letter. Putting your name at the top of the test page is equivalent to signing the James Madison University Honor Pledge.

Total points 234 + Bonus

Name: _____

Test score _____

Date: _____

Grade/12 point scale _____

Geology 230 - EVOLUTION OF THE EARTH - TEST # 2

The Evolution of Life

Spring, xxxx

L. S. FICHTER - JAMES MADISON UNIVERSITY

INSTRUCTIONS:

SCANTRON PORTION

- ☞ *Write your People Soft number on the Scantron card.*
- ☞ Most of the questions are True/False or Multiple Choice
- ☞ Multiple choice questions may have 3, 4, 5, or as many as 20 choices. When there are more than 5 choices they are distributed among more than one question number; for example, a question may have 20 choices with choices 1-5 in question 12, choices 6-10 in question 13, etc.
- ☞ Different questions may have different values, as indicated with each set of questions.
- ☞ Drawing, diagrams, figures required for certain questions are often at the back of the test. You may pull that sheet off to make it easier to answer questions.
- ☞ Observe that on some of the questions the scoring will be “rights minus wrongs.” Such questions are labeled. That is, you get points for a right answer, zero for no answer, and a negative score for wrong answers. Don’t guess!
- ☞ Wrong spellings are not part of the test. I do not deliberately make minor errors, or try to be confusing or ambiguous. If something seems strange assume it is an honest mistake and answer the question as best you can.
- ☞ However, questions may be subtle and complex, read them carefully.

WRITTEN PORTION: (none on this test)

- ☞ A few written questions are at the back, usually as critical reasoning problems.
- ☞ You may accept or reject a statement by demonstrating thoroughly and unambiguously both analytically (logically) and factually (empirically) why the statement needs to be rejected or accepted.
- ☞ Also, you may accept a statement by arguing persuasively the processes, conditions, or factual and historical contexts which do indeed indicate the statement is acceptable.
- ☞ Or, you may reject a statement by demonstrating that some alternative is in fact correct.

To receive full credit, however, your explanations must cut to the heart of the issue. Your answers should be as thorough and logical as the answers you are learning to write for the critical reasoning exercises. That is, the written answers should be clear, concise, and definitive; they should boil all the information dealing with the question down to its essence and present a complete and logical development of ideas. Drawings should be used wherever appropriate and must be large, neat, and well labeled.

Multiple Choice: 3 points each, 9 points total:

For each of the questions below choose an answer from the table to the right.

Estimated number of living species that have been named and described?
 1. A=1A, B=1B, C=1C, D=1D, E=2E
 2. A=2A, B=2B, C=2C, D=2D, E

Choose From Among These			
1A	100,000	2A	50 million
1B	150,000	2B	100 million
1C	500,000	2C	1.5 billion
1D	1 million	2D	5 billion
1E	5 million	2E	50 billion

Estimated total number of species that may have existed in earth history?
 3. A=1A, B=1B, C=1C, D=1D, E=2E
 4. A=2A, B=2B, C=2C, D=2D, E=2E

Estimated total number of fossil species named and described?
 5. A=1A, B=1B, C=1C, D=1D, E=2E
 6. A=2A, B=2B, C=2C, D=2D, E=2E

RIGHTS MINUS WRONGS MULTIPLE CHOICE

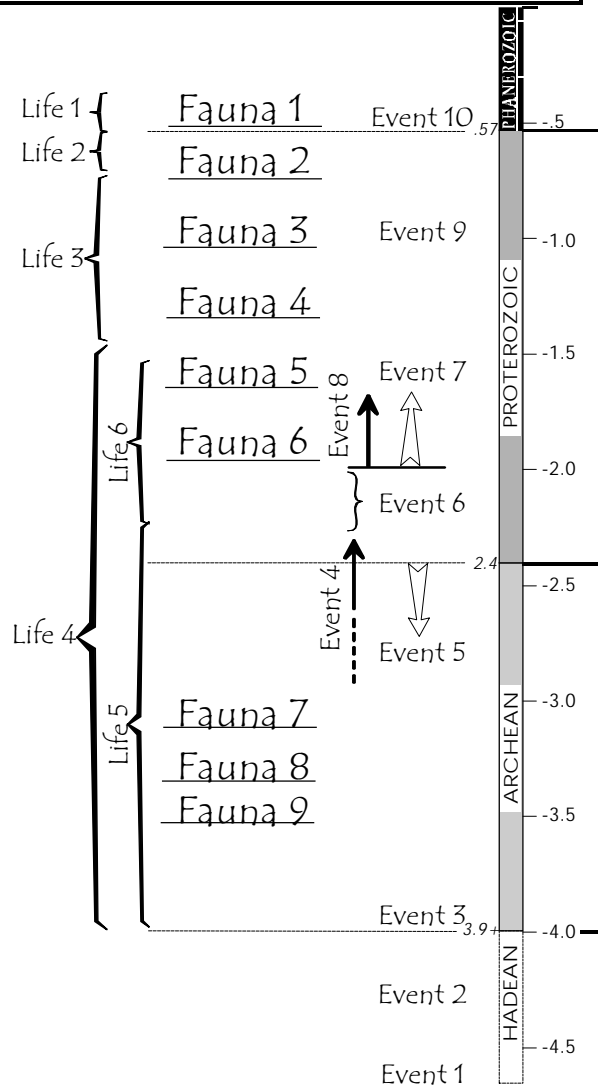
QUESTIONS: 3 points each, 9 points Total. Using choices in the table below, identify the correct fauna from the right diagram to go with correct age.

Choose From Among These			
1A	Beck Springs	2A	Fig Tree
1B	Bitter Springs	2B	Gunflint
1C	Burgess shale	2C	Onverwacht
1D	Chengjiang	2D	Paradise Creek
1E	Ediacara	2E	Warawoona

Fauna 1 Which is Fauna 1 from the table above?
 7. **1A** **1B** **1C** **1D** **1E**
 8. **2A** **2B** **2C** **2D** **2E**

Fauna 6 Which is Fauna 6 from the table above?
 9. **1A** **1B** **1C** **1D** **1E**
 10. **2A** **2B** **2C** **2D** **2E**

Fauna 7 Which is Fauna 7 from the table above?
 11. **1A** **1B** **1C** **1D** **1E**
 12. **2A** **2B** **2C** **2D** **2E**



RIGHTS MINUS WRONGS MULTIPLE CHOICE

QUESTIONS: 3 points each, 21 points Total. For the same figure as the last page, but using the table to the right, identify the fauna associated with the event in each of the questions below.

First Photosynthesis. Identify the fauna where this event most likely first appears in the record.

13. 1A 1B 1C 1D 1E
14. 2A 2B 2C 2D 2E

Fauna Event Occurred In

1A	Fauna 1	2A	Fauna 6
1B	Fauna 2	2B	Fauna 7
1C	Fauna 3	2C	Fauna 8
1D	Fauna 4	2D	Fauna 9
1E	Fauna 5	2E	

First Protists. Identify the fauna where this even most likely first appears in the record.

15. 1A 1B 1C 1D 1E
16. 2A 2B 2C 2D 2E

First Multicellular Life. Identify the fauna where this even most likely first appears in the record.

17. 1A 1B 1C 1D 1E
18. 2A 2B 2C 2D 2E

For the same table as the last question, but using the table to the right identify the event.

Major BIF deposits. Identify the “event” where this even most likely first appears in the record.

19. 1A 1B 1C 1D 1E
20. 2A 2B 2C 2D 2E

Fauna Event Occurred In

1A	Event 1	2A	Event 6
1B	Event 2	2B	Event 7
1C	Event 3	2C	Event 8
1D	Event 4	2D	Event 9
1E	Event 5	2E	

First Red Beds appear. Identify the “event” where this even most likely first appears in the record.

21. 1A 1B 1C 1D 1E
22. 2A 2B 2C 2D 2E

Where life’s oxygen crisis occurred. Identify the “event” where this even most likely first appears in the record.

23. 1A 1B 1C 1D 1E
24. 2A 2B 2C 2D 2E

Oldest rocks on earth. Identify the “event” where this even most likely first appears in the record.

25. 1A 1B 1C 1D 1E
26. 2A 2B 2C 2D 2E

THE PROBLEM OF PROBLEMS

True/False QUESTIONS: 2 points each, 22 points total:

27. T/F. Philosophically one can have a *vitalist* viewpoint without being a *finalist*, but one cannot be a *naturalist* and a *vitalist* at the same time.
28. T/F. The second law of thermodynamics states that entropy always increases and that this can be measured by the amount of disorder in a system, or by how uniformly heat is distributed in a system, the more uniform the distribution the higher the entropy.
29. T/F. The effect of positive feedback is to keep a system going in the direction it is already going, whether the direction is continued increase, or continued decrease.
30. T/F. $X(1-X)$ is the negative feedback in the X-next equation.
31. T/F. A dissipative structure violates the second law of thermodynamics.
32. T/F. A top-down strategy is one in which facts gathered by observation (empiricism) are used to understand how the world is put together and works.
33. T/F. The X-next equation is a good example of a top-down strategy because we are able to observe how it works by iterating out the equation.
34. T/F. The computational viewpoint says that the universe behaves like a computer.
35. T/F. X_{next} is deterministic at low values of “r” but not high values of “r”.
36. T/F. A deterministic system typically does not exhibit emergent properties.
37. T/F. Complexity theory argues that the only thing controlling the rate of evolution of a system is the rate of bifurcation in the system.

RIGHTS MINUS WRONGS MULTIPLE CHOICE QUESTIONS: 3 points each, 24 points Total. At the back of the test is a page of 15 illustrations, some of which deal with chaos, and complexity. Of the **15 choices** in each box, **choose as many** as are appropriate and necessary to answer the questions in the boxes below.

Fixed (point) Attractor: mark one or more of the 15 choices directly exhibiting this property. If none leave all blank.

- | | | | | |
|--------|----|----|----|----|
| 38. 1A | 1B | 1C | 1D | 1E |
| 39. 2A | 2B | 2C | 2D | 2E |
| 40. 3A | 3B | 3C | 3D | 3E |

Strange Attractor: mark one or more of the 15 choices directly exhibiting this property. If none leave all blank.

- | | | | | |
|--------|----|----|----|----|
| 41. 1A | 1B | 1C | 1D | 1E |
| 42. 2A | 2B | 2C | 2D | 2E |
| 43. 3A | 3B | 3C | 3D | 3E |

Fractal Geometry: mark one or more of the 15 choices directly exhibiting this property. If none leave all blank.

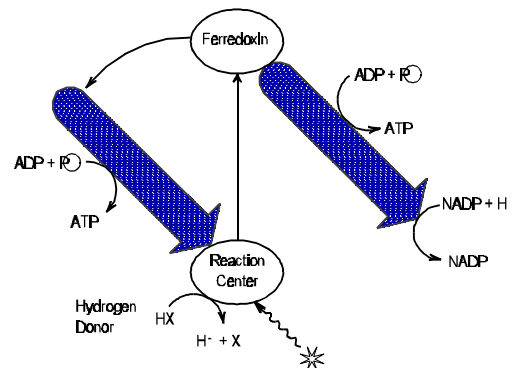
- | | | | | |
|--------|----|----|----|----|
| 44. 1A | 1B | 1C | 1D | 1E |
| 45. 2A | 2B | 2C | 2D | 2E |
| 46. 3A | 3B | 3C | 3D | 3E |

SAME ILLUSTRATIONS AS LAST QUESTIONS, BUT TRUE/FALSE QUESTIONS; 2 points each, 10 points total:

47. T/F. **Non-linear phenomena:** Illustration **2C** is an example of a non-linear phenomena.
48. T/F. **Bifurcation:** Illustration **1E** is an example of bifurcation.
49. T/F. **Iteration:** Illustration **3E** is produced by iteration.
50. T/F. **Emergent Property:** Illustration **1C** is an example of an emergent property.
51. T/F. **Negative Feedback:** **3B** is an example of a system experiencing Negative Feedback.

True/False QUESTIONS: 2 points each, 30 points total: The Archean was a time during which life invented its major biochemical systems. The following questions explore your understanding of that history.

52. T/F. Although cell theory says all cells come from preexisting cells, the process of symbiosis demonstrates this is not always true.
53. T/F. We know that all life on earth is related because the universal tree of life shows their connections.
54. T/F. The oldest source of biochemical energy was fermentation.
55. T/F. Earliest life was probably able to get by without ATP.
56. T/F. Green and purple sulfur bacteria invented nitrogen fixing.
57. T/F. Photosynthetic reaction center II was invented because electron transport chains were unable to split water.
58. T/F. Precursor BGA created both the hydrogen crisis and the oxygen crisis.
59. T/F. Sulfur reducing bacteria probably evolved before the desulfovibrios.
60. T/F. Anaerobic photosynthesis generates as a byproduct pure sulfur.
61. T/F. The main resource limiting the growth of the precursor BGA population was the shortage of Fe_2CO_3
62. T/F. The earth would have lost its water, just as Mars did, if it were not for its sequestering in the sediments of the earth's crust.
63. T/F. Oxygen did not begin to accumulate in the earth's atmosphere until the invention of aerobic photosynthesis.
64. T/F. Mitochondria probably evolved at about the same time as the Blue Green Algae.
65. T/F. The biochemical systems in the drawing to the right were almost completely invented by the green and purple sulfur bacteria.
66. T/F. This biochemical system (right) would have contributed to the development of the oxygen atmosphere.



RIGHTS MINUS WRONGS MULTIPLE CHOICE QUESTIONS: 3 points each, 66 points Total.

For each of the groups of organisms below, indicate the **one** time span they were most abundant or most important. You must choose only from the options listed in the table below.

1A	Vendian	2A	Late Paleozoic	3A	Whole Mesozoic
1B	Whole Paleozoic	2B	Mid/Up Paleozoic	3B	Lower Mesozoic
1C	Cambrian	2C	Mississippian	3C	Cretaceous
1D	Ordovician	2D	Pennsylvanian	3D	Cenozoic
1E	Middle Paleozoic	2E	Permian	3E	Recent

Ediacara					Oldest Trace Fossils						
67.	1A	1B	1C	1D	1E	70.	1A	1B	1C	1D	1E
68.	2A	2B	2C	2D	2E	71.	2A	2B	2C	2D	2E
69.	3A	3B	3C	3D	3E	72.	3A	3B	3C	3D	3E

Pancake/Ribbon Phyla					Trilobite Abundance						
73.	1A	1B	1C	1D	1E	76.	1A	1B	1C	1D	1E
74.	2A	2B	2C	2D	2E	77.	2A	2B	2C	2D	2E
75.	3A	3B	3C	3D	3E	78.	3A	3B	3C	3D	3E

Small Shelly Fossils					Inarticulate Brachiopods						
79.	1A	1B	1C	1D	1E	82.	1A	1B	1C	1D	1E
80.	2A	2B	2C	2D	2E	83.	2A	2B	2C	2D	2E
81.	3A	3B	3C	3D	3E	84.	3A	3B	3C	3D	3E

Articulate Brachiopods					Burgess Shale Fauna						
85.	1A	1B	1C	1D	1E	88.	1A	1B	1C	1D	1E
86.	2A	2B	2C	2D	2E	89.	2A	2B	2C	2D	2E
87.	3A	3B	3C	3D	3E	90.	3A	3B	3C	3D	3E

Tabulate/Strom Reefs					First Starfish						
91.	1A	1B	1C	1D	1E	94.	1A	1B	1C	1D	1E
92.	2A	2B	2C	2D	2E	95.	2A	2B	2C	2D	2E
93.	3A	3B	3C	3D	3E	96.	3A	3B	3C	3D	3E

First Abundant Nautiloids					First Vascular Plants						
97.	1A	1B	1C	1D	1E	100.	1A	1B	1C	1D	1E
98.	2A	2B	2C	2D	2E	101.	2A	2B	2C	2D	2E
99.	3A	3B	3C	3D	3E	102.	3A	3B	3C	3D	3E

First Ammonoids					First Jawed Fishes						
103.	1A	1B	1C	1D	1E	106.	1A	1B	1C	1D	1E
104.	2A	2B	2C	2D	2E	107.	2A	2B	2C	2D	2E
105.	3A	3B	3C	3D	3E	108.	3A	3B	3C	3D	3E

Labyrinthodont Amphibians					Waulsortian reefs mounds						
109.	1A	1B	1C	1D	1E	112.	1A	1B	1C	1D	1E
110.	2A	2B	2C	2D	2E	113.	2A	2B	2C	2D	2E
111.	3A	3B	3C	3D	3E	114.	3A	3B	3C	3D	3E

Therapsids prominent					First mammals					
115.	1A	1B	1C	1D	1E	118.	1A	1B	1C	1D 1E
116.	2A	2B	2C	2D	2E	119.	2A	2B	2C	2D 2E
117.	3A	3B	3C	3D	3E	120.	3A	3B	3C	3D 3E
First Paleozoic fauna					First Scleractinian corals					
121.	1A	1B	1C	1D	1E	124.	1A	1B	1C	1D 1E
122.	2A	2B	2C	2D	2E	125.	2A	2B	2C	2D 2E
123.	3A	3B	3C	3D	3E	126.	3A	3B	3C	3D 3E
First Ichthyosaurs/Plesiosaurs abundant					First Angiosperm plants					
127.	1A	1B	1C	1D	1E	130.	1A	1B	1C	1D 1E
128.	2A	2B	2C	2D	2E	131.	2A	2B	2C	2D 2E
129.	3A	3B	3C	3D	3E	132.	3A	3B	3C	3D 3E

THE EVOLUTION BETWEEN LIFE AND EARTH:

THE GAIA HYPOTHESIS

TRUE OR FALSE; 2points each; 6 points total.

133. T/F. The early water supply of Venus and Mars was probably lost by the photo disassociation of H₂O by ultraviolet radiation and the subsequent loss of the hydrogen to space.
134. T/F. Eukaryotes are essentially composed of prokaryotes living together.
135. T/F. Teleology is a belief that the phenomena of organic life can be fully explained only by the action of design and purpose.

RIGHTS MINUS WRONGS MULTIPLE CHOICE QUESTIONS: 3 points each, 15 points total:

<p>A</p> $\text{H}_2\text{S} \rightarrow \text{H}_2 + \text{S}^0$ <p style="text-align: center;">↓</p> $\text{H}_2 + \text{CO}_2 \rightarrow \text{Sugar}$	<p>B</p> $\text{H}_2\text{O} \rightarrow \text{H}_2 + \text{O}_2$ <p style="text-align: center;">↓</p> $\text{H}_2 + \text{CO}_2 \rightarrow \text{Sugar}$ <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 5px auto;"> $\text{CO}_2 + \text{H}^+ + \text{O}_2 \xrightleftharpoons[\text{night}]{\text{day}} \text{Sugar}$ </div>	<p>C</p> $4\text{H}_2 + \text{CO}_2 \rightarrow 2\text{H}_2\text{O} + \text{CH}_4$	<p>E</p> $\text{H}_2 + \text{CO}_2 \rightarrow \text{Sugar}$ <p style="text-align: center;">↑</p> $\text{H}_2\text{O} \rightarrow \text{H}_2 + \text{O}_2$ <p style="text-align: center;">↓</p> <p>BIF ← Fe₂CO₃ + O₂</p>
<p>D</p> $\text{SO}_4^{2-} + \text{H}_2 \rightarrow \text{H}_2\text{S} + \text{H}_2\text{O}$			

136. *Desulfovibrios*. The biochemical strategy used by these organisms are which from the table above?
A, B, C, D, E
137. *Precursor Blue Green Algae*. The biochemical strategy used by these organisms are which from the table above?
A, B, C, D, E
138. *The generation of methane*. The biochemical system generating methane is (from the table above).
A None of the choices in the table.
B Choice B

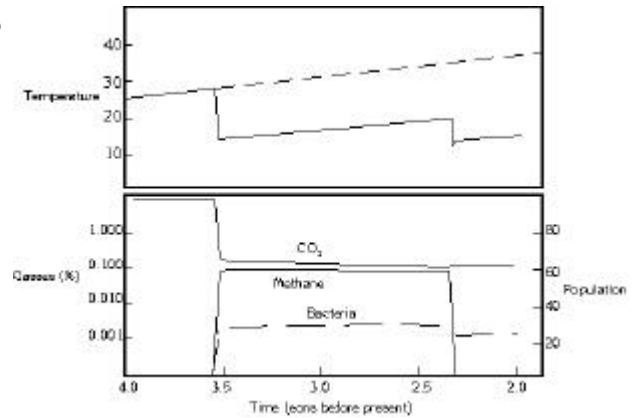
- C Choice C
- D Choice D
- E Choice E

139. **The generation of free oxygen in the atmosphere.** The biochemical system accompanying the accumulation of oxygen into the atmosphere (from the table above).

- A, B, C, D, E

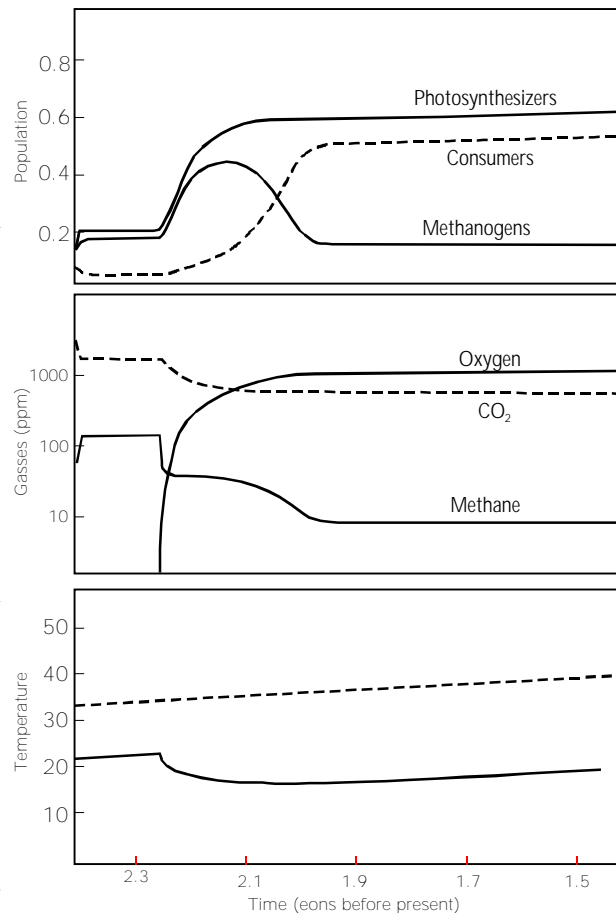
140. **White Daisies.** The part of the graph to the right acting as the white daisies is.

- A CO₂
- B Methane
- C Bacteria



TRUE OR FALSE; 2 points each, 22+bonus points total: BONUS system. Each identification is worth 3 points, plus you get one bonus point for each one you get correct after the first one.

- 141. T/F. The rise of oxygen occurs because the methanogens decline in importance.
- 142. T/F. It is during this time that photosynthesizers first evolved.
- 143. T/F. Banded Iron Formation deposition does not occur with the appearance of abundant oxygen in this diagram.
- 144. T/F. Methane declines primarily because it is destroyed by oxygen.
- 145. T/F. The decline in temperature at 2.2 billion years ago has nothing directly



to do with the rise of methanogen.

146. T/F. Temperature declines primarily because of the drop in CH₄
147. T/F. Although consumers rise in abundance, they have no real influence on the other variables in the graph.
148. T/F. Methane does not drop directly to its lowest level primarily because the methanogen population is rising.
149. T/F. In the graph, oxygen and CO₂ balance each other out because they react with one another.
150. T/F. In this graph, methanogen make a significant contribution to the decline in CO₂ because of the reaction $\text{H}_2 + \text{CO}_2 \rightleftharpoons \text{CH}_4 + \text{H}_2\text{O}$.
151. T/F. Consumers are able to expand their population only because they require oxygen to make the Krebs cycle work.

Write your People Soft number on the Scantron card.