Rubric for Modeling Essay Questions

Question 1: Explain why you chose each component depicted. Describe the relationships among all your components. What ecological process or processes does your model best depict?	
Content Understanding Goal: Ecological diversity	
Level	**Examples**
0: Not score-able; no response.	"I don't know."
1 point: Poorly applies diversity, very general	Interactions between biotic and abiotic factors
2 points: Minimally applies one diversity concepts	The insect diversity in the meadow is greater because of more moisture.
3 points: Adequately applies diversity concepts to research project	Meadows tend to have greater diversity of primary producers due to increased sunlight than forested site…
4 points: Shows mastery of diversity concepts, appropriately applies several concepts to research project	The presence of large woody debris may have more significantly impacted arthropod diversity than the absence of a canopy.

Question 2: Develop hypothesis, (or re-write hypothesis) using components in model. Describe how hypothesis (or secondary hypothesis) will be tested.	
Learning Goal: Understand how to develop a testable hypothesis	
Level	**Examples**
0: Not score-able; no response.	"I don't know."
1 point: Poor	The clear cut will better handle disturbance because it has greater diversity.
2: Minimal, needs restructuring.	What is the diversity in the meadow v.s. a forest?
3: Adequately forms a testable hypothesis.	How does log decomposition effect arthropod diversity?
4: Shows mastery in forming a clear, testable hypothesis and describe method of testing hypothesis.	Species richness in fungivore arthropods will be greater in the forest opening than the forest. Measure species richness of fungivore arthropods captured in forest opening and in the forest at the same time, same experimental design.

Question 3: Choose I biotic component. List or describe as many subcomponents within that. Explain if redundancy might apply or not.	
Learning Goal: Understand Ecological hierarchy and redundancy	
Score	**Examples**
0: Not score-able; no response.	"I don't know."
1: Poorly applies understanding of subcomponents	Although the species might not be the same, there were approximately the same

	number of species…
2: Minimally applies understanding of subcomponents, no mention about redundancy	The guild with the largest biomass was… predaceous arthropods.
3: Adequately applies subcomponents, some misconceptions about redundancy	Herbivore species richness was higher in the meadow, with large populations of different any species.
4: Shows mastery of understanding subcomponents and redundancy	The forested site had a g a number of predators unique to the forest, including two types of harvestmen…providing resiliency… to allow it to function as a system in a disturbance.

Question 4: Discuss and illustrate feedback. Choose one component in your system and describe one change over short-term period. Describe any indirect effects you could expect. How could the patterns appear differently over longer time scales?	
Learning Goal: Understanding complexity in Ecosystems, show Feedback and trace through possible indirect effects	
Score	**Examples**
0: not score-able; no response.	"I don't know."
1: Poor understanding of feedback and indirect effects,	One example of feedback is the vegetation in the meadow.
2: Shows minimal understanding of and application of feedback, minimal ability to describe indirect effects,	A change in arthropods would ricochet up the food web and the entire ecosystem.
3: Shows good understanding of and application of feedback, but less proficient describing indirect effects. Only describes one plausible pattern of change (short term)	Ecosystems function through varied array of relationships that are usually nonlinear and include many complex feedback loops…
4:Expertly understands and applies both feedback and indirect effects (4 points). Describes plausible patterns of changes over short and long time spans (4 points)	Feedback loops may have negative impacts (competition) placing limits on growth of herbivores…it may accelerate the rate of growth of plants over the short term, but due to feedback, not in the long term.

Question 5: Add specific disturbance, show how effects are propagated through system. Predict consequences of disturbance, describe experiment to test your prediction.	
Learning goal: Ability to make accurate predictions, design a secondary experiment.	
Score	**Examples**
0: Not score-able; no response.	"I don't know."
1: Poor effects, no predictions, no experiment	The meadow could handle the effects of a drought better than the forest because the forest would become more susceptible to

	disease.
2:. Minimally shows effects, poor predictions, poor experiment	Fire could change the soil respiration. You could collect data in a patch before and after a fire
3: Adequately shows how effects are propagated through system, makes modest predictions, designs ok experiment to test this.	After a hot "crown: fire, fungal and bacterial elements of soil will have been eliminated, and the forest will take a longer time to recover its intricate relationships than the meadow…post-fire experiments could quantify the loss of soil microbes…
4: Expertly shows how effects are propagated through the ecosystem, makes plausible predictions, designs plausible experiment to test this.	A fire would immediately increase light reaching the ground, and burning would release nutrients, stimulating herbaceous growth…short term, plants are not dependent upon symbiants, may no longer feed the microbes…burn a test plot and take measurements over time…

Question 6: How do you think complex ecosystems function? Explain your reasoning, the better able it might be to withstand	
Learning Goal: Understand ecological complexity	
Level	**Examples**
0: Not score-able; no response.	"I don't know."
1: Poor response	Complex systems are interdependent and, like lasagna, you can't tell the function of one part by just observing the final product.
2: Makes some errors in discussing aspects of complexity	Complex ecosystems move in and out of balance…
3: Adequately discusses several aspects of complexity	Patch level dynamics may play a significant role in succession at local sites… what happens over time in each patch may not conform to typical successional trajectories…
4: Expertly describes the causal mechanisms of systems, i.e., feedback, direct and indirect and multiple effects, pattern over different time and space scales, subcomponents,	The greater the order of complexity, the better able it will be to withstand degradation…fungi providing nutrients to vegetation provides positive feedback loop…multiple levels of relationships might provide compensatory pathways to overcome the loss of other species over time…