Name: _____ Class: _____ Date: _____

3.6 Grading the Explanations Tool for Ecosystems: Why does the meadow ecosystem need so much grass to support so few foxes?

Carbon TIME Discourse Routine around the Explanations Tool:

1. *Introduction: Students review their Evidence-Based Arguments Tools. Establish the purpose for completing the tool as developing a complete explanation for the unit phenomenon.*
2. *Private thinking and writing: Students complete the Explanations Tool individually.*
3. *Partner or small group work: Students share and compare ideas in pairs/small groups, with the goal of improving their explanations.*
4. *Sharing ideas in whole-class discussion: Class discussions serve to elicit, clarify, and compare explanations from individual students and/or student groups.*
5. *Consensus-seeking discussion accompanied by public writing: Class discussions focus on coming to consensus around a correct, coherent explanation that answers the Three Questions while addressing the 4 steps. We recommend that students revise their explanations in a different colored pen/pencil.*

*This worksheet has "grading" in the title because at this point, students can be held accountable for correct answers. Level 4 (correct) responses to the questions are in **blue bold italics** below.*

Red italics suggest ways to grade student responses by giving them points for correct or partially correct answers. There are 17 points total on this worksheet.

In a stable meadow ecosystem, which pools are carbon atoms in?

Carbon atoms are in the atmosphere, soil, producer, herbivore, and carnivore pools.

1 point for identifying each pool;5 points total

What processes are causing carbon atoms to move from one pool to another?

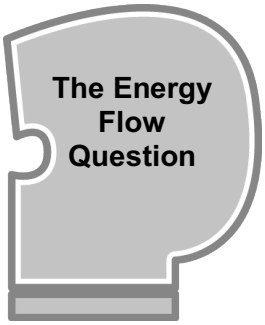
Photosynthesis and cellular respiration, death, defecation, and eating.

1 point for each process; 5 points total

Why are there more carbon atoms in the producer pool than in the herbivore and carnivore pools?

When herbivores eat the producers (grass), most of the high-energy carbon-based molecules are used for movement and functioning, which means that a lot of the carbon atoms are released into the air during cellular respiration in the form of carbon dioxide. This happens again when carnivores eat herbivores. So in each step up the organic matter pyramid more carbon atoms are lost to the air (or to death and defecation) than are transformed into biomass.

1 point for explaining that carbon atoms are lost to the air through cellular respiration



Sunlight is the only source of energy for the meadow ecosystem. How is that light energy transformed in the meadow ecosystem?

Plants transform light energy into potential chemical energy during photosynthesis in their cells. Some of this energy is stored in carbon-based molecules and used to construct the bodies of the plants, while other energy is used for movement and functioning and is lost to the atmosphere as heat. When herbivores eat the plants, the chemical potential energy in the plant organic matter is transferred from the producer to the herbivore pool. In the herbivore's body, the energy is either used for movement and functioning through cellular respiration, or used for biosynthesis. In the case of the former, energy is lost again to the environment as heat. In the case of the latter, the energy is contained in carbon-based molecules and stored in the body of the herbivore as organic molecules. When the carnivore eats the herbivore, the same transfer and transformation occurs.

1 point for explaining what happens to the energy from sunlight to plant, plant to herbivore, and herbivore to carnivore; 3 points total

Explain in words: Why does the meadow ecosystem need so much grass to support so few foxes? (Answer on the back) *Use this Explanations Tool to help guide your written explanation, being sure to answer the first three of the Four Questions.*

Remember: **Atoms last forever** (if atoms leave one pool they must enter another).

Good explanations will include at least one sentence addressing the Carbon Pools Question, the Carbon Cycling Question, and the Energy Flow Question, based on the answers that students have written for these questions above.

1 point for answering each of the first three of the Four Questions in the explanation; 3 points total