





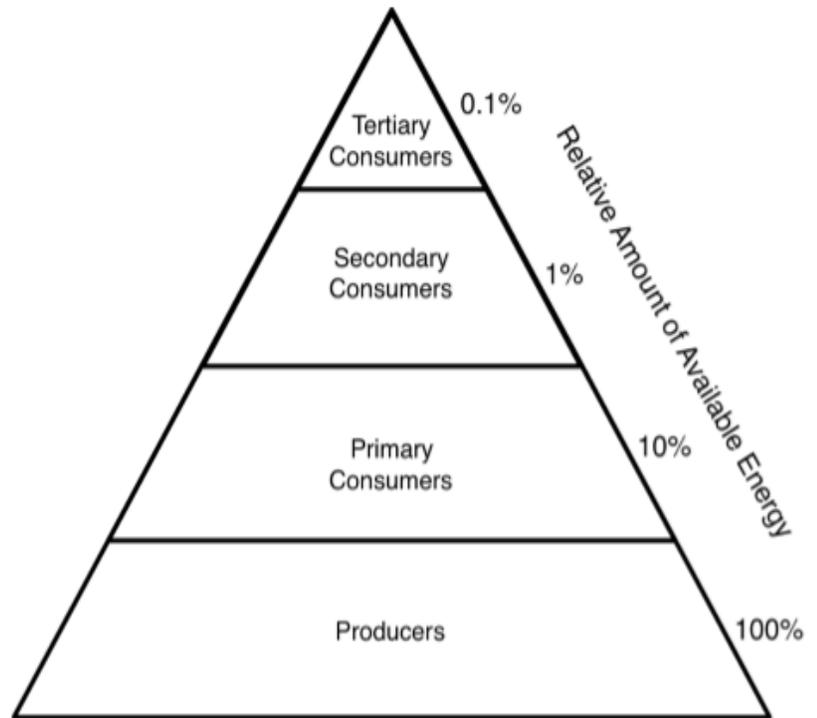


## Creating Webs and Chains to Model Ecological Relationships: Student Handout

### Part 2: Quantifying energy flow and the rule of 10 percent

*Three hundred trout are needed to support one man for a year. The trout, in turn, must consume 90,000 frogs, that must consume 27 million grasshoppers that live off of 1,000 tons of grass. -- G. Tyler Miller, Jr., American Chemist (1971)*

Only a small fraction of energy available at any trophic level is transferred to the next trophic level. That fraction is estimated to be about 10 percent of the available energy. The other 90 percent of the energy is needed by organisms at that trophic level for living, growing, and reproducing. This relationship is shown in the energy pyramid above. It suggests that for any food chain, the primary producer trophic level has the most energy and the top trophic level has the least.



8. Why is a pyramid an effective model for quantifying energy flow?
  
9. Place the organisms from your original food chain on the pyramid provided (located on final page).
  
10. Using the rule of 10 percent in energy transfer, record the species names for each trophic level and the amount of energy available at that level if your producer level had 3,500,000 kilocalories of energy/area.



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11. In one or two sentences, describe how the available energy may affect the population sizes of organisms at different trophic levels.

### **Part 3: Creating a food web**

Food chains are simple models that show only a single set of energy-transfer relationships, but many organisms obtain energy from many different sources and in turn may provide energy to several different consumers. A food web illustrates all these interactions and is a more accurate model of how energy moves through an ecological community.

12. Starting with your original food chain (question 5), add another plant and four more animal cards to construct a food web that shows how energy flows from producers through primary consumers, secondary consumers, tertiary consumers, and possibly a quaternary consumer. When making your food web, you can have more than one arrow leading to and from each organism. Draw a version of your food web below.



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13. In one or two sentences, describe any patterns you notice in the relationships between trophic levels.

14. Now choose and read a different disturbance card and predict its impact on your food web. Complete the table below:

Disturbance (list the title)	Brainstorm some ecosystem impacts that could result from your disturbance	Predict how these impacts would affect each trophic level
		Producer:  Primary consumer:  Secondary consumer:  Tertiary consumer:

15. Describe whether some trophic levels benefit from the disturbance while others do not. If humans caused the disturbance, was it negative or positive for each trophic level in the food chain?



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### **Part 4: Model evaluation**

In science, models are used to represent explanations and predications. The food chain, food web, and energy pyramid are all models that show feeding relationships and allow us to make predictions. Compare and contrast the strengths and weaknesses of each model by filling in the table below.

Model	List two things this model is useful for illustrating or predicting	Identify one feature that this model lacks or one that could lead to a misconception
Food chain	1. 2.	
Energy pyramid	1. 2.	
Food web	1. 2.	

16. Select the model that you think is most effective in representing relationships among organisms in Wisconsin and justify your choice in two or three sentences.



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