Exercise 1: Concept Mapping for Synthesis

(Due Feb. 3)

Introduction

In this exercise you will create a concept map to identify both the key ecological concepts in Ecological Stoichiometry and the relationships among them. Concept mapping is an analytical tool that specifies a way to represent concepts and their relationships. It requires the creator organize the concepts and provides a summary representation of the knowledge. The specific learning goals of this exercise are to:

- Practice using formal analytical tools to organize and represent knowledge, and
- Construct a synthetic understanding of Ecological Stoichiometry.

Concept Map

In final form concept maps are a diagram or graph of relationships between concepts. There are three basic steps to concept mapping. The first is to identify the primary or key concepts in the subject area you are mapping. The next step is to identify and briefly characterize the relationships between the concepts. The concepts and relationships can then be drawn out diagrammatically (see Figure 1 for an example). In these maps, "boxes" represent concepts and the relationships that link the concepts are drawn as lines. In some cases it is useful to label the type of relationship that links two concepts. The Wikapedia entry on concept maps (http://en.wikipedia.org/wiki/Concept_map) provides a nice general introduction to the topic, and http://www.tiehh.ttu.edu/scox/niche.html/niche_map.html provides an example map for the niche concept.

There are many ways to organize concepts; they are context dependent. Therefore, there cannot be one correct answer to this exercise, though they can be more or less valid or accurate (Taylor 1993). Taylor (1993, p. A-8) notes that "a concept map is an individual picture of the understanding you had developed at the time you made the map." They synthesize your understanding into one diagram that can serve as a reference point. As your understanding of the topic grows or the science develops, your concept map can change. While they do not have one correct answer, we can identify three strong reasons to develop concept maps. First, the overwhelming value of concept mapping comes from the process (Taylor 1993). In developing the map, your understanding of the topic will likely clarify. The map is a tool to synthesize the concepts into a larger picture. Second, the map itself becomes a place holding representation of your current understanding. As your understanding develops, you can return to your previous maps and identify specifics of how your understanding has changed. Finally, the concept map can be used as a communication tool to quickly share your understanding. Perhaps you will include a concept map in your final reflection paper or presentation for this class.

Ford (2000, Chapter 3) argues that representing ecological theories as concept maps or theory networks is an important tool to begin research. This is because "scientific research requires that we place the subjective process of developing new ideas into a logical framework" (Ford 2000, p. 41). Conceptual analysis inherent in concept mapping is a way to construct the logical framework that underlies new scientific research. While Taylor's maps allow a wide variety of relationships between concepts that are then described along the connection, Ford restricts the relationships to three types: one concept is a part of another, P; a concept is a kind of another, K; and one concept is a property of the connected concept, H (Figure 2). Ford's approach forces a particular formalism to the map that you may find more or less useful.

Ultimately, the concept map can be a tool to identify what the existing field looks like (conceptually) and to distinguish the types of research progress that have been made and what needs to be accomplished next.

Assignment

Your assignment is to create a concept map for Ecological Stoichiometry. This topic involves many of the core concepts in ecology and links to several other disciplines, especially chemistry. Part of your challenge will be to show how these different ideas are related under the umbrella discipline of ecology. If you need, you may introduce concepts not present in our readings to form bridges, but please clearly identify them (perhaps using a different shape for their "box"). You may choose to use either Ford or Taylor's approach. You may draw these concept maps by hand, but there are now many software tools that you can download and use. CMAP (http://cmap.ihmc.us/conceptmap.html) is one that I have found useful recently.

References

Ford, E. D. 2000. Scientific method for ecological research. Cambridge University Press, Cambridge; New York.

Taylor, M. 1993. Appendix Four: Concept Mapping: A Technique for Learning. Pages A8-A9 *in* N. A. Campbell, editor. Biology. The Benjamin/Cummings Publishing Company, Inc., Redwood City.

Figure 1: Example concept maps from Taylor (1993). Notice how the relationship between two concepts (in boxes) is described along the connecting line.

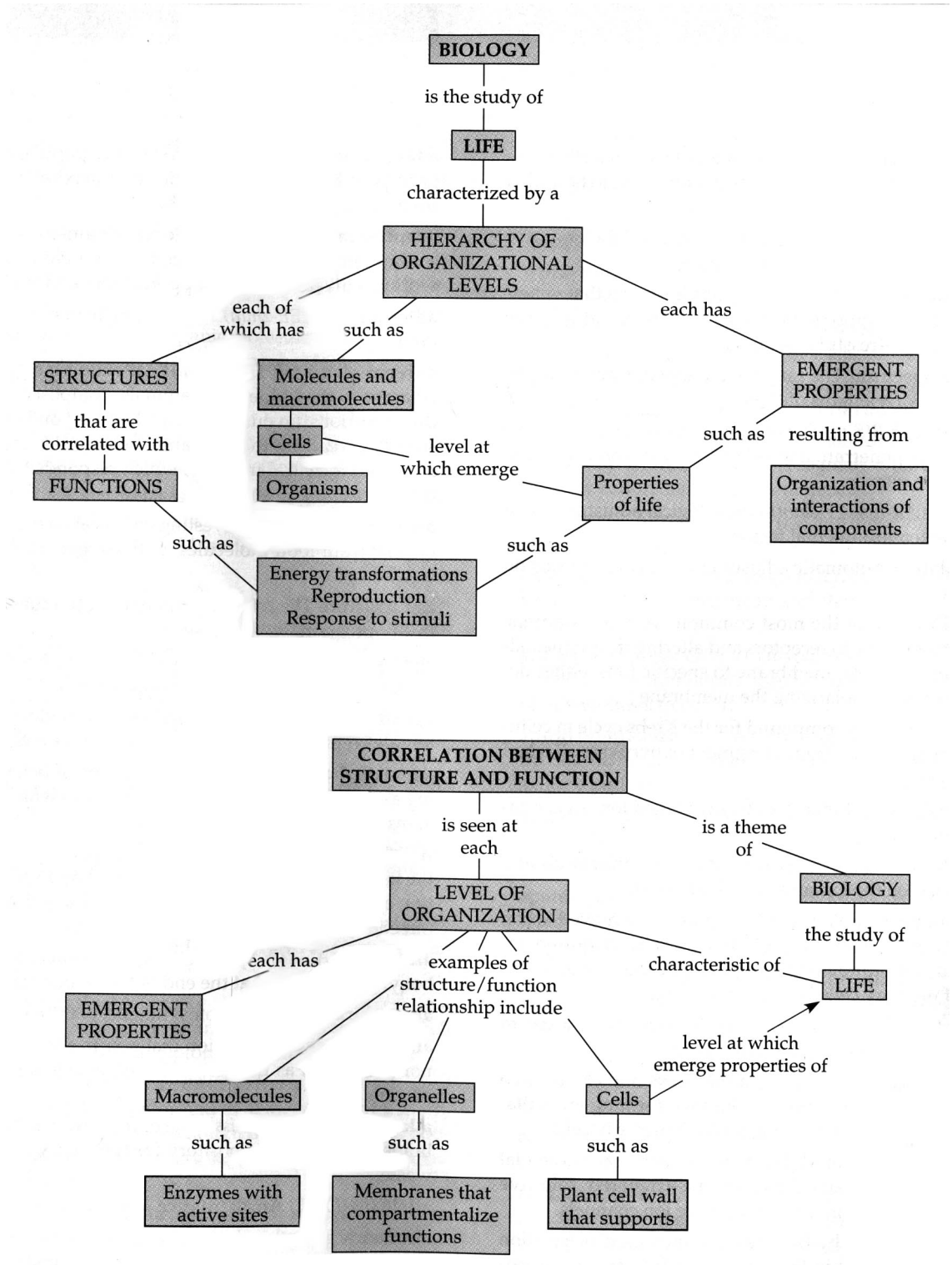

Figure 2: Example partial concept maps from Ford (2000)

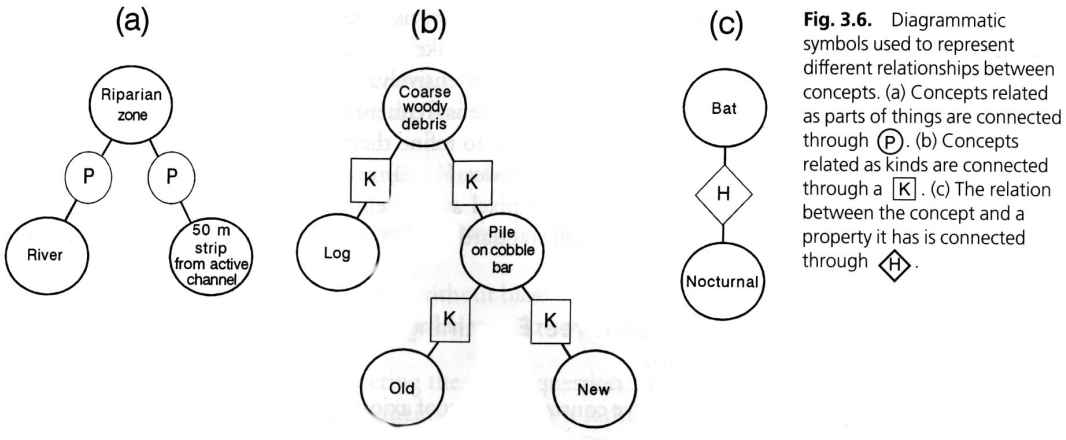

Fig. 3.6. Diagrammatic symbols used to represent different relationships between concepts. (a) Concepts related as parts of things are connected through (P). (b) Concepts related as kinds are connected through a [K]. (c) The relation between the concept and a property it has is connected through ⟨H⟩.