

**Chapter 5**

**PLUGGING INTO ENERGY FLOW**

**OVERVIEW:** The lessons of Biosphere II should provide stark reminders of the finiteness of Biosphere I, the life support system of Earth. The lecture (see outline) will highlight the comparison of the Biosphere II “model” with the Earth with lessons for us as “passengers.” Food webs and food pyramids are also used as models of energy flow with specific implications for food human practices.

**BLUEPRINT:** Read Chapter 5, pages 90-99, for an understanding of how we as humans share the web of life with other creatures upon whom we are caused to depend, and which have been entrusted to our care.

**VOCABULARY:**

food pyramid	ecological vs economic value
food web	detritus food web
community stability	grazing food web
agricultural ecosystem	

**LEARNING GOALS:** You can measure your mastery of this assignment by completing the following:

1. List and explain five ways in which Biosphere II helps you to understand how Biosphere I serves to support life on Earth.
2. How do thermodynamic laws point to a ‘beginning’ and a ‘supernatural creation’ of the universe?
3. How is the atmosphere both a protective “filter” and a sheltering “blanket?” How might human activities be affecting both?
4. Why is it more economical to obtain food calories and protein from beans than from beef?
5. What is meant by “stability” of biotic communities? Your friend says she doesn’t understand why all of the commotion about saving species from extinction when there are so many anyway. How should *stability* apply to this discussion?

**CONSTRUCTION:** Write answers to Questions #3 through #6 at the end of Chapter 5, perhaps after lecture. Leave space between questions for later notes.

## STUDY OUTLINE: ENERGY FLOW AND FOOD WEBS

### I. LESSONS FROM "BIOSPHERE II" FOR "BIOSPHERE I"

(See "BIO 100 Web Links" Page, and click on 'Biosphere II Web Site' under Assignment #5).

#### A. EARTH IS A FINITE SYSTEM WITH BOUNDARIES

1. ATMOSPHERE is like the GLASS
2. FINITE SPACE AND RESOURCES

#### B. EARTH DEPENDS UPON A CONTINUOUS ENERGY SUPPLY FROM SUN

1. ENERGY =
  - > potential energy = stored energy; at rest; [coal/oil/gas reserves; forests]
  - > kinetic energy = energy at work; motion [molecules, fluids, gases; warm temp.]
2. THERMODYNAMIC LAWS -- describe behavior of energy
3. IMPLICATION for ORIGIN of the UNIVERSE
  - a. 1st LAW suggests an outside creator because \_\_\_\_\_
  - b. 2nd LAW -- had to be a starting point because \_\_\_\_\_

#### C. ATMOSPHERE CONTROLS ENERGY BALANCE OF EARTH -- by "clearness of roof"

1. Stratospheric Ozone (O<sub>3</sub>) -- filters ultraviolet radiation
2. CO<sub>2</sub>, CH<sub>4</sub>, and CO -- trap heat from escaping --> provide "greenhouse effect"
3. Global Warming –

INTERNET: See "BIO 100 Web Links" Page, and click on Assignment #7, 'Global Warming Updates'

#### D. AUTOTROPHS SUPPORT LIFE ON EARTH

1. INFLUENCE GASEOUS COMPOSITION OF ATMOSPHERE <Priestley>
2. PHOTOSYNTHESIS allows life to "plug into" energy flow - Figure 5-4

#### E. THERMODYNAMICS INFLUENCES FOOD SUPPLY

1. NATURAL ECOSYSTEM -- Figure 5-5
2. AGRICULTURAL FOOD PYRAMID --

F. BIODIVERSITY INFLUENCES STABILITY --> Food Web Model (Figure 5-6)

1. FEATURES -- resident populations...energy flow paths...trophic niches

2. CHARACTERISTICS OF NATURAL COMMUNITIES:

a. COMPLEXITY --

b. STABILITY --

3. AGRICULTURAL SYSTEMS

a. RATIONALE -- increase \_\_\_\_\_

NOTE: Agriculture doesn't create ENERGY... just influences "path" of energy

> HERBICIDES/CULTIVATION - eliminate \_\_\_\_\_

> INSECTICIDES -- eliminate \_\_\_\_\_

b. ENVIRONMENTAL IMPACTS:

i. LOSS OF BIODIVERSITY -- directly, or by habitat destruction

ii. LOSS OF STABILITY

iii. CHEMICAL POLLUTION -- pesticides, fertilizers

iv. SOIL EROSION and SALINIZATION

V. WORLD FOOD ENERGY YIELDS -- FACTORS TO CONSIDER: TABLE 5-1

A. CROPLAND AVAILABLE

B. POPULATION DENSITY

C. Can you add others? -->

VI. QUESTION TO CONSIDER: Based upon trends in food production and world population (Table 5-2), can we conclude that the Earth's capacity for food production has been reached? Note your current thoughts; we will return to this later.