

## You in the Food Chain

### Introduction

If you eat food, you are part of the food chains on Earth. To be conscientious about our place in the biosphere, you should know where you are positioned in various food chains. This exercise will allow you to look at your food habits from a new perspective and will perhaps encourage you to make changes in your diet that will benefit both the environment and you health as an individual. The food chain refers to energy flow in an ecosystem. It is commonly represented in terms of trophic levels:

- **First trophic level** - green plants (autotrophs) that obtain their energy from the sun and matter from the air and soil or water.
- **Second trophic level** - primary consumers (herbivores), animals that obtain their energy and matter from the consumption of plants (first trophic level).
- **Third trophic level** - secondary consumers (predators), animals that obtain their matter and energy from the second trophic level (herbivores).

In addition, some animals obtain their matter and energy by eating

both plants and animals, and therefore operate at several trophic levels. These organisms are known as **omnivores**.

Every time food energy is transferred "up" another level up the food chain, a large amount of the energy in the food is lost as heat. Therefore, if you eat plants, which are lower in the food chain, you are using fewer of the Earth's finite resources than if you consume animal products.

There are additional environmental impacts associated with animal product consumption. These include water use, manure management and odor production. Consuming animal products requires consumption of fresh water as well. If freshwater is in limited supply, this may be a serious environmental concern. Manure produced by farm animals can be considered a resource or a liability; it is an excellent resource when used as a soil fertilizer and conditioner but a liability when it is not contained in a sanitary manner. If storage systems are inadequate and leaks occur, surface and groundwater may be contaminated. Contaminated water can pose threats to human health. Surface water contamination due to leakage of manure lagoons has been

responsible for large fish kills. If you do not know how the animals or animal products you consume are produced, then you really cannot know the environmental impacts of your choices.

**Assessing Your Impact**

The energy-producing value of food is measured in Calories. In this exercise you will determine the percentage of Calories (the

same thing as kilocalories, or kcal) in your diet that come from plants and from animals. This will allow you to determine in which trophic levels of the food chain your food habits put you.

To try to estimate the relative impact of your diet on the planet's resources you will use the USDA protein conversion ratios in Table 1, below.

**Table 1.** Estimated protein conversion ratio and plant equivalent for various animal products.

<b>Animal Food Product</b>	<b>Protein Conversion Ration (PCR)*</b>	<b>Estimated Plant Equivalent (EPE) in plant kcal/lb**</b>
Beef	16	26,400
Pork	6	9,900
Turkey	4	6,600
Eggs	3	4,950
Chicken	3	4,950
Fish	Depends on where the fish is in the food chain	4,950***
Milk	1	1,650
Cheese	10	16,500

\* Approximate number of pounds of grain or soy fed to get one pound of animal product

\*\* 1,650 kcal per pound of dry grain was used for this estimate.

\*\*\* An estimated PCR of 3 for any fish was used.

These show the pounds of grain or legume protein necessary to be fed to animals to allow the growth of 1 pound of animal food product. With this data, you can estimate the total pounds of plant food

products you consume either directly (by eating grains, fruits, vegetables, or other plant foods) or indirectly (by eating animal food products such as meat, fish, poultry, eggs, and dairy products).

You will also calculate the percentage of kcal from fat. Considerable research by the American Heart Association and other groups proves that a high-fat diet (at or above 40% of total kcal) is a major contributing factor in cardiovascular disease (heart attacks, strokes, high blood pressure, etc.). On the other hand, a low-fat diet (near or below 30% of total kcal) can help prevent these conditions. Generally, animal food products are higher in fat than plant food products, so eating lower on the food chain may be beneficial to your health as well as to the planet's well-being.

There is also mounting evidence that low-fat diets are useful in preventing cancer, perhaps due to the fact that many environmental contaminants, including some carcinogenic pesticides, are fat-soluble molecules. When organisms higher in the food chain consume other organisms that contain contaminants, they store those contaminants in their fat tissues because they have no mechanism for getting rid of them or using them for energy as they do with the proteins, carbohydrates, and fats they consume. These harmful chemicals can increase in concentration as they pass up the food chain (a phenomenon known as **biomagnification**). So, if you eat

more fat, you take the chance of consuming more environmental contaminants as well.

### Materials

- Any reference for Calorie and fat content of foods (for an on-line version try the Nutritional Analysis Tool at [www.ag.uiuc.edu/~food-lab/nat/](http://www.ag.uiuc.edu/~food-lab/nat/))

### Procedure

To do this dietary analysis, you need to record all the foods you consume for three days. Write down everything you consume (both food and beverages) from the time you awaken until you go to sleep. Be sure to estimate the size of the portions you consume.

Try to choose three days that represent a rather "average" day for you. Everyone eats differently every day, and this analysis would be better if your food diary was kept over a longer period, so remember your that results are just estimates. If you normally skip a meal, choose days when you have done this. Do not include a day in which you attend a special event that includes foods atypical of your normal food choices. Do not choose a day when you consume very little (for whatever reason).

All quantities are simply estimated for this exercise because there is no practical way

to obtain exact numbers for portion size, kcal in portions, or any other number. Do not fret over details; you are looking for trends.

1. Record everything you consume each day for three days in Data Table 1, including your food choices and the portion sizes you eat. If you eat a food that contains many ingredients, leave sufficient blank rows for breaking down the food into at least its five main ingredients. For example, if you ate spaghetti with tomato and meat sauce, there are three main ingredients, so you have to estimate the portion of tomato sauce and the portion of meat in what you consumed. For all higher trophic level foods consumed, you also need to estimate the weight of the portion you consumed. If you need additional space, download additional copies of Data Table 1 from the class website.
2. For each food eaten, classify the food as from either 1) the "first trophic level" (plants and fungi) or 2) a "higher trophic level" (animals or animal products). (You will include any mushroom or fungi with the plants, although neither would be biologically classified as

plants or as functioning in the first trophic level because they do not photosynthesize).

3. Use your dietary reference source to look up the Calories (kcal) and grams of fat contained in each food. You may have to do a little math to calculate the kcal and grams of fat in the portion you ate relative to the serving size. You will have to convert your portion size to an equivalent serving size. Use the following formulas to convert the data to fit your consumption:
  - **kcal in serving** =  
(serving size you ate x kcal/serving in reference)
  - **g fat in serving** =  
(serving size you ate x g fat/serving in reference)
4. For all first trophic level (plant-based) foods you consumed, the Estimated Plant Equivalent (EPE) of the food is the kcal in the portion consumed. For these foods, transfer the data from column F to column H in Data Table 1.
5. For all higher trophic level foods you consumed, calculate the EPE using the following formula and record in column I of Data Table 1. The EPE per pound of higher trophic level

food is found in Table 1. This is where you will need your estimate of the weight of the portion you consumed. Remember that you only do this for higher trophic level foods.

- **EPE in serving** = EPE in 1 lb. x portion of a lb you ate
6. Calculate totals for columns F through I for each day and record in Data Table 2.
  7. Compute the mean daily values for total kcal consumed, kcal consumed from first trophic level, first trophic level EPE, and higher trophic level EPE and record in last row of Data Table 2.
  8. Calculate the mean daily percentage of kcal you consume from the first trophic level by using the following formula and record in Data Table 3:
    - **Mean daily % kcal 1<sup>st</sup> trophic level** = ((mean daily total kcal from 1<sup>st</sup> trophic level) divided by (mean daily total kcal from all trophic levels)) x 100

9. Calculate the mean daily percentage of kcal from fat by using the following formula and record in Data Table 3:

- **Mean daily % kcal from fat** = ((mean daily total g fat x 9 kcal/g) divided by (mean daily total kcal)) x 100

**Table 2.** Total daily estimated plant equivalents (EPE) (kcal) used per person by country.

Country	Total daily estimated plant equivalents used by person (kcal)
United States	8,000
Italy	4,000
China	3,000
India	2,000

*Page left blank intentionally*

**You In The Food Chain LAB WRITE-UP:** Submit pages 7-12

Student Name: \_\_\_\_\_ Lab Date: \_\_\_\_\_  
 Lab Instructor: \_\_\_\_\_ Section #: \_\_\_\_\_

**Data Table 1.** Individual student food diary for three days.

- See pages 10 - 12

**Data Table 2.** Mean daily total kcal consumed from first trophic, total g fat, and total EPE.

Day	Total kcal consumed	Total kcal consumed from 1 <sup>st</sup> trophic level	Total g fat	Total EPE
Day 1				
Day 2				
Day 3				
<b>Total =</b>				
<b>Mean daily =</b>				

**Data Table 3.** Mean daily percentage of kcal consumed from first trophic level and mean daily percentage of kcal from fat.

Mean daily % kcal consumed from first trophic level:	
Mean daily % kcal consumed from fat:	

**Conclusions (Questions)**

1. Evaluate how your daily percentage of kcal from the first trophic level compares with nutritional guidelines, which state that an adult consuming a diet of 2,000 kcal per day should consume about 70% of the day's total kcal from the first trophic level. A total vegetarian would get 100% of the day's total kcal from the first trophic level. How does you intake compare?

---



---



---



---



---

2. Evaluate your daily mean Estimated Plant Equivalency intake using the latest nutritional food guidelines, which state that an adult consuming a diet of 2,000 kcal per day should consume about 30% of the day's total kcal from the higher trophic levels. A total vegetarian would get all of his or her kcal from the first trophic level, so would consume an EPE of 2,000 kcal. Using the guidelines and assuming that the adult consumes the recommended two glasses of milk and two servings (2 ounces each) of meat, the EPE would be about 6,000 kcal. How does your intake compare?

---

---

---

---

---

---

3. Discuss the environmental effects of your place in the energy flow of our planet. Compare how your place in the biosphere, as demonstrated by your dietary choices, relates to the dietary composition of persons from other cultures. Use the estimated data in the Table 2 on page 5 to help you make this comparison.

---

---

---

---

---

---

4. To promote a healthy diet, the American Heart Association encourages the consumption of a diet that provides less than 30% of its daily kcal from fat. Higher levels of fat consumption have been associated with heart disease and cancer. How does your diet compare?

---

---

---

---

---

---



5. How do you think your fat consumption relates to fat consumption in other parts of the world? Think about the source of the majority of your fat calories.

---

---

---

---

---

6. What dietary changes could you make to lessen the impact of your diet on the planet?

---

---

---

---

7. Do you know how the animal products you consumed were produced? Theorize about the effects that the manure produced along with the animal products might have on the environment.

---

---

---

---

---

8. Where are **you** in the food chain? If you consume 100% of your kcal from the first trophic level, you are a vegan or total vegetarian and function at the second trophic level. If you consume between 30% and 70% of your kcal from the first trophic level, you function at the second and third trophic levels. If you consume less than 30% of your kcal from the first trophic level, you probably function at the second through fourth trophic levels (it is not possible to determine which). To restate the question, in which trophic levels do your dietary choices place you?

---

---

---

---

---

**Data Table 1.** Individual student food diary by day for each of three days.

<i>(Record)</i>				<i>(Record from reference)</i>			<i>(Calculate)</i>				
<b>DAY 1</b>	Trophic Level		A	B	C	D	E	F	G	H	I
	First	Higher	Portion consumed	Estimated Portion Weight	Serving size	kcal per serving	g fat per serving	kcal in portion	g fat in portion	First Trophic Level EPE	Higher Trophic Level EPE
Food Item											
<b>Day 1 Totals:</b>											

**Data Table 1.** Individual student food diary by day for each of three days. *Continued.*

(Record)				(Record from reference)			(Calculate)				
DAY 2 Food Item	Trophic Level		A	B	C	D	E	F	G	H	I
	First	Higher	Portion consumed	Estimated Portion Weight	Serving size	kcal per serving	g fat per serving	kcal in portion	g fat in portion	First Trophic Level EPE	Higher Trophic Level EPE
<b>Day 2 Totals:</b>											

**Data Table 1.** Individual student food diary by day for each of three days. *Continued.*

(Record)				(Record from reference)			(Calculate)				
DAY 3 Food Item	Trophic Level		A	B	C	D	E	F	G	H	I
	First	Higher	Portion consumed	Estimated Portion Weight	Serving size	kcal per serving	g fat per serving	kcal in portion	g fat in portion	First Trophic Level EPE	Higher Trophic Level EPE
<b>Day 3 Totals:</b>											