Exercise and Nutrition

Objectives:

1. Understand the relationship between exercise and diet.
2. Create a reasonable daily energy budget.
3. Accurately present results in the form of pie diagrams.

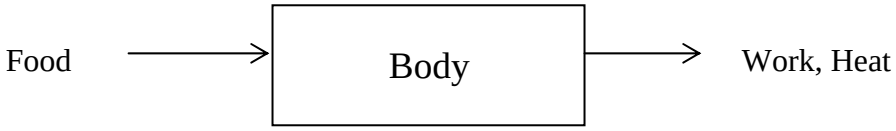
Concepts:

Energy is commonly measured in units called calories. A calorie is so small that it is not very useful for discussing exercise or nutrition. The "calories" that we use to discuss energy in food or exercise are really kilocalories (1,000 calories) or sometimes written kcal or Calorie (with a capital C). Throughout this exercise we will be using kilocalories (Calories).

Introduction:

Food serves three important functions. It provides **essential nutrients** that the body cannot synthesize. It provides necessary **building blocks** for synthesizing macromolecules. It provides a source of **chemical energy**. In most industrialized societies the first two functions are easily met, and **deficiency diseases** are very rare. However, imbalances in energy are a major problem for many people.

We can think of the body as a "black box" through which energy flows. Energy enters as food, measured in Calories, and leaves in the form of work or heat (also measured in Calories).



If the energy input (food) exceeds energy output (work, heat) the body gains weight. If the energy output exceeds the energy input the body loses weight. From this perspective, it doesn't matter what type of food enters the body. Celery can be just as fattening as chocolate, although you would have to eat about 30 stalks of celery to get the same number of Calories as there are in a chocolate candy bar!

Methods:

You are now ready to create a realistic energy budget. In the first step you will estimate your total energy expenditures for a day. You will then design a diet plan that meets these energy needs. Multiply the figures in the 'Energy Expenditure' column by your weight (kg) to get the overall energy expenditure (kcal/hr). As you might expect a larger person expends more energy for a given activity than a smaller person does.

Table 1: Energy required for some common activities.

Activity	Energy Expenditure (kcal/hr/kg)*	Weight (kg) 1kg = 2.2 lbs	Overall Energy Expenditure (kcal/hr)
Sleeping	0.9		
Sitting	1.2		
Standing	1.5		
Eating	1.4		
Driving	2.2		
Piano Playing	2.4		
Walking	4.8		
Jogging (11 min./mile)	8.1	_____ kg	
Running (8 min/mile)	12.0		
Swimming	7.8		
Playing Basketball	8.3		
Bicycling (6 mph)	3.6		
Bicycling (10 mph)	6.0		
Cooking	2.7		
Playing Cards	1.5		
House Cleaning	3.6		

*These values include "maintenance energy" that your body requires for essential physiological processes. This basal metabolism would be the amount of energy expended if you were lying perfectly still in a room that was at room temperature.

Example: Consider the energy budget for a 68 kg (150 lb.) male college student, shown in Table 2. Energy expenditure (kcal) was calculated by multiplying the energy expenditure (kcal/hr) from Table 1 by the number of hours that the activity was done.

Table 2: Energy Budget for a 68 kg male.

Activity	Hours	Calories / hour	Total Calories Expended
Sleeping	8	61	488
Sitting (in class or studying)	5	81	405
Cleaning the apartment	1	245	245
Walking	2	325	650
Eating	2	85	190
Standing	3	100	300
Sitting watching TV	2	80	160
Bicycling at 6 mph	1	245	245
	24	**Total Calories Expended/Day**	2,683

Use Table 3 below to calculate an energy budget for a typical day in your life. Be sure that you account for 24 hours of total activity. If an activity is not listed in Table 1 you should make a reasonable estimate based upon similar activities listed in the table.

Table 3: Energy Budget for a Typical Day

Activity	Hours	Calories/Hour	Total Calories Expended
		Total Calories Expended/Day =	

Using the charts provided by your instructor, calculate your Basal Metabolic Rate (BMR).

The total in Table 3 includes the energy spent on basal metabolism. Any energy that is expended over the basal metabolism is energy that is actually used to carry out the activities listed above.

How much of your energy budget is used for basal metabolism? _____ Calories

How much is actually used for the activities listed in the table? _____ Calories

Assignment, Part 1:

Prepare a one-day diet plan for yourself in Table 4. The plan must include enough calories to meet the estimated energy expenditure you have calculated in Table 3 – and NO MORE! (Coming up a few calories short is OK). That is, you want your 'Total Calories Consumed' to equal your "Total Calories Expended.' The diet plan should also meet the recommendations from the U.S. Department of Agriculture about fat consumption, i.e. no more than 30% of total calories should come from fat and no more than 10% of total calories from saturated fat.

This should be an 'ideal plan.' It will not necessarily be a list of what you normally eat, unless, of course, your current diet conforms to the USDA's recommendations.

It is best to fill out the table in pencil, as you will probably have to adjust and re-adjust the plan as you learn more about caloric content and fat content of foods.

You can find information on the web about food at the following sites: Nutrition Data at http://www.nutritiondata.com, Fast Food Nutrition Fact Explorer http://www.fatcalories .com/ , or USDA National Nutrient Database http://www.nal.usda.gov/fnic/cgi-bin/nut_search.pl.

Much of the information about fat, protein, and carbohydrates in these data bases is given in grams. If you know the amount in grams of any of these molecules, you can calculate the number of calories from that.

All fat has 9 Calories per gram, whether it is saturated or unsaturated. Proteins and carbohydrates each have 4 Calories per gram. Here is how you can convert from grams of these food molecules, to Calories per food item.

number of grams of fat x 9 Cal./gram = number of Cal. in fat
number of grams of carbohydrate x 4 Cal./gram = number of Cal. in carbohydrate,
number of grams of protein x 4 Cal./gram = number of Cal. in protein.

For example, a serving of a certain brand of cookies contains 1 gram of protein, 19 grams of sugar, and 7 grams of fat. Six of the 7 grams of fat are saturated. Using the formulas from above:

Food item	Total Calories	Fat calories	Protein Calories	Carbohydrate Calories	Saturated Fat Calories
Cookies	143	7g x 9 Cal/g = 63 Cal.	1g x 4 Cal/g = 4 Cal.	19g x 4 Cal/g = 76 Cal.	6g x 9Cal/g = 54 Cal.

These conversion factors are averages, so the sum of the subtotals may not exactly equal the total calories provided in the data base. You should use the sum of the subtotals for the Total Calories column. This will simplify the presentation of your results at the end of the exercise.

You also need to remember that saturated fat is included in total fat. So, when you calculate total calories:

Total Calories = Total Fat Calories + Protein Calories + Carbohydrate Calories

(In other words, do not include "Saturated Fat Calories' when calculating 'Total Calories. Saturated Fat Calories' are already included in 'Fat Calories.')

Table 4: A Diet Plan for One Day, which conforms to the USDA Guidelines for Fat Consumption.

Breakfast

Food Item & Serving Size	Total Fat Grams	Total Fat Calories	Protein Grams	Protein Calories	Carb. Grams	Carb. Calories	Total Calories	Saturated Fat Grams	Saturated Fat Calories
Total Grams									
Total Calories									

Lunch

Food Item & Serving Size	Total Fat Grams	Total Fat Calories	Protein Grams	Protein Calories	Carb. Grams	Carb. Calories	**Total Calories**	Saturated Fat Grams	Saturated Fat Calories
Totals for Grams									
Total for Calories									

Dinner

Food Item & Serving Size	Total Fat Grams	Total Fat Calories	Protein Grams	Protein Calories	Carb. Grams	Carb. Calories	**Total Calories**	Saturated Fat Grams	Saturated Fat Calories
Totals for Grams									
Totals for Calories									

Snacks

Food Item & Serving Size	Total Fat Grams	Total Fat Calories	Protein Grams	Protein Calories	Carb. Grams	Carb. Calories	Total Calories	Saturated Fat Grams	Saturated Fat Calories
Totals for Grams									
Total for Calories									

Table 5: Total Calories from each Type of Biological Molecule in an 'Ideal Plan'

	Fat	Protein	Carbohydrate	Saturated Fat*
Total Calories/Day				
Percentage of each source of calories for the day				

Percentages from Fat, Protein, and Carbohydrate should add up to about 100%.

*Saturated Fat Calories are included in the Total Fat Calories. You are keeping track of them in the table so you can figure out what percentage of your total calories they are.

Assignment, Part 2. Suppose that you decide to eat lunch at a fast food restaurant. You order a large specialty hamburger (Whopper®, Big Mac®, etc.), large French fries, and a large soda. Complete the table below with the nutritional data for this meal.

Fast Food Lunch

Food Item & Serving Size	Total Fat Grams	Total Fat Calories	Protein Grams	Protein Calories	Carb. Grams	Carb. Calories	Total Calories	Saturated Fat Grams	Saturated Fat Calories
Totals for Snacks									

Use Table 6 to substitute the calories in the fast food lunch for the calories in your 'ideal lunch, and recalculate your total energy intake for the day.

Table 6: Calculating Calories in Plan with Fast Food Lunch

	Fat	Protein	Carbohydrate	Saturated Fat*
Total Calories in "Ideal Plan"				
Subtract Total Calories in Ideal Lunch				
Add Total Calories in Fast Food Lunch				
Total Calories in Plan with Fast Food Lunch				

Table 7: Total Calories and Percent Calories from each Type of Biological Molecule in a Meal Plan That Includes a Fast-Food Lunch

	Fat	Protein	Carbohydrate	Saturated Fat*
Total Calories/Day				
Percentage of each source of calories for the day				

Results:

Following the guidelines for graphing, present the results of your research using pie graphs. Be sure to graph both the original diet plan and the modified plan that includes a fast food meal.

Each of your graphs should show what percentage of your daily calories came from fat, or carbohydrates, and protein. Your totals should add up to about 100%. (You will NOT have a separate 'pie wedge' for Saturated Fat calories; you're calculating Saturated Fat calories because you want to make an "ideal plan" with fewer than 10% of the calories from Saturated Fat. Saturated Fat is a risk factor for high cholesterol levels; hence the advice to avoid it.)

Discussion:

How similar is the ideal plan to your normal food intake ?

Have you learned anything in this exercise that is particularly surprising ?

Based on your results, is it possible for a Fast Food meal to be part of a diet which conforms to the USDA's recommendations?