ASSESSMENT OF ENERGY EXPENDITURE

THREE-DAY ACTIVITY RECALL

An individuals total energy expenditure (TEE) comprises the number of calories expended during **physical activity**, the number of **calories needed to digest food (DIT)** and the number of calories expended during sleep (**BMR**).

PHYSICAL ACTIVITY ENERGY EXPENDITURE

Any hope of changing the pattern and quality of daily physical activity must be predicated on an accurate appraisal of the daily energy expenditure. Maintenance of body weight and body composition is controlled by a relatively simple interaction of diet and physical activity (although each itself is extremely complex). Diet corresponds to the fuel for the system, or "input" (refer to homework assignment #1) and physical activity is the expenditure of the fuel, or "output". When the input does not equal output, the system is out of balance and energy (in the form of body weight) is not maintained. For example, if your average daily diet consists of 2130 kCal, but your average daily energy expenditure is only 1880 kCal, then on any day you would be taking in 250 more kCals than you are expending. That may not seem like much (about 3 cookies), but over time calories add up. In two weeks you would have expended 3500 kCals less than you have eaten. That is approximately equal to one pound of fat. If you continue on the same diet and physical activity pattern for a whole year, you will probably weigh nearly 26 lbs heavier than if you were in caloric balance.

Similar to the accuracy of dietary surveys, physical activity diaries usually estimate total energy expenditure within 10% of your true energy expenditure. Before recording your daily physical activity, you should once again become familiar with "honest" calorie counting. Your accuracy will depend on your correct recording of activity and duration. For the physical activity diary, you will only require three things: 1) a watch, 2) a small pad, and 3) a pen or pencil.

DIET INDUCED THERMOGENESIS (THERMIC EFFECT OF FOOD)

In healthy individuals, consumption of food temporarily increases metabolism. This is called obligatory thermogenesis and results from the energetic processes of digestion, absorption, and assimilation of nutrients by the body. Generally, DIT reaches a maximum within an hour of eating a meal and ranges between 10-35% of the total calories consumed during the meal.

However, interpersonal variability is great, and DIT for any individual depends on both the quantity and composition of food eaten.

For the purpose of this assignment, we will disregard calculations of the DIT.

BASAL (RESTING) METABOLIC EFFECT

You spend considerable time during the day sleeping (or resting quietly). The energy expenditure (or metabolic rate) during sleep is referred to as your Basal Metabolic Rate or BMR, and is proportional to the body surface area (BSA) expressed as meters squared (m^2). The BMR is typically expressed as kCal per meter squared body surface area per hour ($kCal/m^2/h$). It can also be expressed as kCal expended per min, or per hour. For many individuals the BMR contributes the greatest amount to the total energy expenditure (TEE).

In this assignment you will estimate your basal metabolic rate (BMR) from your body surface area, which is a function of your stature (height) and body mass (weight.)

DETERMINING TOTAL ENERGY EXPENDITURE

Step 1. Determine daily pattern of energy expenditure, including such minimal daily requirements as sleeping (BMR), eating, sitting (sleeping) in class, bathing, and voluntary physical activity. An activity profile can be constructed by keeping a *daily log* for three days of the actual time allotted to the various activities that represent your usual pattern of activity. To illustrate the procedure, Table 1 shows a fairly detailed activity profile for a college professor during a typical day of summer vacation. This record includes a description of the activity, its duration, and the calories expended during the activity. [Tables 2, 3, and 4 are activity logs for you to use, if you wish.]

Step 2. You need to have an estimate of your caloric expenditure during sleep (BMR). Determine BMR from body surface area (BSA, m^2), as follows:

a) BSA $(m^2) = 0.20247 \times \text{Stature}^{0.725} \times \text{Body Mass}^{0.425}$

Example

Male: stature, 1.778 m (177.8 cm; 70 in); body mass, 75 kg (165.3 lb)

$BSA = 0.20247 \times \text{stature}^{0.725} \times \text{body mass}^{0.425}$

$BSA = 0.20247 \times 1.778^{0.725} \times 75^{0.425}$

$BSA = 0.20247 \times 1.51775 \times 6.2647$

$BSA = 2.055\ cm^2$

[NOTE: it is also possible to estimate BSA using the data in figure 14-7 of your text]

(b) Determine Basal Metabolic Rate (BMR) from BSA

The BMR (in $kCal \bullet min^{-1}$) can be calculated for men and women using the following equations:

MEN: $BMR\ (kCal \bullet min^{-1}) = (38 \times BSA, m^2) \div 60$

WOMEN: $BMR\ (kCal \bullet min^{-1}) = (35 \times BSA, m^2) \div 60$

EXAMPLE OF BMR CALCULATION

MALE
Age= 40 y
Stature= 182 cm, (72 in)
Body mass= 86.4 kg (1901b)
Body surface area (from Figure 4-7) = 2.09 m^2

Calculations

BMR ($kCal \bullet min^{-1}$) = (38 x 2.09) ÷ 60
BMR ($kCal \bullet min^{-1}$) = 1.3

Step 3. Determine the energy expenditure in $kCal \bullet min^{-1}$ for each of the activities listed in your profile. For sleep use the BMR computed above. To obtain calorie values for different physical activities you can refer to the appendix in your study guide or consult various web pages.

Step 4. Multiply the tabled energy expenditure values by the number of minutes spent in each activity.

Step 5. Sum the total energy expenditure for each activity, including the value for sleep, to arrive at your total energy expenditure for the day.

Step 6. Repeat steps 2-5 for each of three days. Obtain the average daily energy expenditure for the three day period by summing the total calories expended over the three day period and dividing by 3.

HOW TO INTERPRET YOUR AVERAGE DAILY ENERGY EXPENDITURE

There is no standard for the number of calories you should expend during a day. Many factors are involved, including body size, age, gender, and most importantly your level of physical activity. The average daily energy expenditure is 3000 kcal for men and 2100 kcal for women between the ages of 19 and 22 years. If you are not gaining or losing body weight, then your energy expenditure should equal your energy intake (determined in assignment #1).

ASSIGNMENT

Put your name, an ID number (of your choice), your e-mail address and name of this assignment on the first page. On subsequent pages do not put your name, only our ID number.

Do the following:

1. Prepare three (3) daily activity logs similar to table 1. Use 3 typical days of the week (perhaps 2 weekday and 1 weekend day). Use the logs provided, or make your own).
2. Show all your calculations; including calculations for BSA.

Answer the following questions:

1. Compare your caloric expenditure with your caloric intake from assignment #1. Present and interpret any differences that you find (make a table or graph illustrating these differences). Why are there differences? Be specific.

2. Based on your response to #1 above, do you expect to lose or gain weight over the next 3 months if you maintain the same level of caloric intake and expenditure? Explain your answer. Be very specific.
3. What specific changes do you need to make in your daily food consumption and/or daily energy expenditure for you to achieve your ideal body weight (you will have to choose an ideal weight you would like to achieve to answer this question.) How long (be specific in terms of number of days, weeks or months) will it take you to reach your ideal body weight?
4. Discuss what you discovered in this lab experience. How might this affect the way you eat and exercise in the future?

NOTE:

- Your report will be at least (a minimum) 4 pages long [Table 1 (3 pages- at least one page for each day); Answers to questions]. The report can be longer if the spirit moves you.

Table 1. Detailed record of physical activity for one day for a university professor.

Activity	Begin Time	End Time	Total Minutes	Similar Activity	kCal•min^{-1}	Total kCal
awake, bathroom use	6:45AM	6:53AM	8	standing quietly	2.3	18.4
go back to bed	6:53	7:30	38	BMR	1.3	48.1
eat breakfast	7:30	7:50	10	eating, sitting	2.0	40.0
use bathroom	7:50	8:00	10	standing quietly	2.3	23.0
dress	8:00	8:06	6	standing quietly	2.3	13.8
drive to school	8:06	8:17	11	sitting quietly	2.0	22.0
walk to of office	8:17	8:25	8	walking, normal pace	6.9	55.8
work, pick-up mail	8:25	10:00	95	writing, sitting	25	2375
up/down stairs	10:00	10:10	10	jogging-11min 30 sec pace	11.7	117.0
work in office	10:10	12:10PM	120	writing, sitting	2.5	300.0
go to locker	12:10PM	12:12	2	walking, normal pace	6.9	13.8
get dressed	12:12	12:16	4	standing quietly	2.3	9.2
walk to track	12:16	12:20	4	walk, normal pace	69	D.6
wait for friend	12:20	12:30	10	standing quietly	2.3	23.0
run to park, back	12:30	2:00	90	8-min mile pace	17.2	1553.0
walk to locker	2:00	2:04	4	walk, normal pace	69	27.6
shower, dress	2:04	2:20	16	quiet standing	2.3	36.8
walk to office	2:20	2:24	4	walk, normal pace	69	27.6
meeting/lunch	2:24	3:00	36	eating, sitting	2.0	72.0
work in office	3:00	5:05	125	writing, sitting	2.5	312.5
walk to library	5:05	5:12	7	walk, normal pace	6.9	48.3
work in library	5:12	6:05	53	writing sitting	2.5	132.5
walk to dean's office	6.05	6:10	5	walk, normal pace	6.9	34.5
meeting, dean	6:10	6:35	25	writing sitting	2.5	62.5
walk to of office	6:35	6:43	8	walk, normal pace	6.9	55.2
walk to car	6:43	6:51	8	walk, normal pace	69	55.2
drive home	6:51	7:03	12	sitting quietly	1.8	21.6
change clothes	7:03	7:07	4	standing quietly	2.3	9.2
wash-up	7:07	7:11	4	standing quietly	2.3	9.2
cook dinner	7:11	8.00	49	cooking	4.1	200.9
watch TV	8:00	8:30	30	sitting quietly	1.8	54.0
eat dinner	8:30	9 00	30	eating, sitting	2.0	60.0
mail letter	9:00	9:05	5	walk, normal pace	6.9	345
listen to stereo	9:05	9:30	25	sitting quietly	1.8	45.0
watch TV	9:30	10:30	60	sitting quietly	1.8	108.0
wash-up	10:30	10:38	8	stanting quietly	2.3	18.4
read in bed	10:38	11:15	37	Iying at ease	1.9	70.3
sleep	11:15	6:15AM	450	BMR	1.3	585.0
					Daily Total =	**4583**

Table 2. Activity Log

Activity	Begin Time	End Time	Total Minutes	Similar Activity	$kCal \bullet min^{-1}$	Total kCal
					Daily Total =	

Table 3. Activity log.

Activity	Begin Time	End Time	Total Minutes	Similar Activity	kCal•min^{-1}	Total kCal
					Daily Total =	

Table 4. Activity log.

Activity	Begin Time	End Time	Total Minutes	Similar Activity	$kCal \cdot min^{-1}$	Total kCal
					Daily Total =	