



## The Law of Thermodynamics

As fad diets have come and go, one theory on altering body composition has withstood the test of time: The First Law of Thermodynamics. Thermodynamics is the study of energy, and with regards to altering body composition energy is calories.

### Formal Definitions

- Law of Energy Conservation states that energy is always conserved; it cannot be created or destroyed. In essence, energy can be converted from one form into another.
- The First Law of Thermodynamics states the change in the internal energy of a system is equal to the heat added to the system minus the work being done from the system

### Translated Definition for Application

We will express energy as calories in this equation.

***The individual will maintain their weight if:***

Total Calories consumed per day = Total Calories expended per day

***The individual will gain weight if:***

Total Calories consumed per day > Total Calories expended per day

***The individual will lose weight if:***

Total Calories consumed per day < Total Calories expended per day

Interestingly enough as the epidemic of obesity continues to rise, so too is the average caloric intake of the American adult. The National Health and Nutrition Examination Survey have reported that caloric intake has risen by approximately 10% each day. With caloric intake increasing and daily activity decreasing it is easy to see how obesity has risen.

## Science vs. Life

The Law of Thermodynamics is undisputable on face value. If it is so undisputable and easy to compute, why then the obesity? Obesity is much more than number crunching, obesity deals with the ability to control the mental and physical connection with food. The variable of obesity is many and the answers are not easy.

## Variables

- **Genetics** – Genetics has been used as a limitation for those seeking weight management. Even taking genetics into account there still is a calorie intake vs. calorie expenditure debate
- **Calorie is a calorie?** - On face value yes, but upon further review no. Fatty, sugary foods digest differently in the human body and can cause biochemical reactions adverse to calorie control.
- **Individual Digestive Systems** - Types of food react differently from person to person.
- **Hectic Schedules** - causing eating on the go or missing meals.
- **Emotional Stress** – This topic is potentially the biggest of them all
- **Social & Lifestyle Patterns**
- **Lack of education** - as it relates to nutrition

There is no one size fits all solution to the issues and variables listed above. I believe education is a great place to start on understanding your body and how to win the thermodynamics game. Beyond education I believe a support team has many benefits for an individual. Fitness professionals and physical educators for general support, dieticians for prescribed eating plans, psychologists for understanding the emotions of why you are eating, and most importantly family support for daily accomplishment.

## How Many Calories Should You Eat?

For an individual food analysis and food plan a dietician is a great place to begin. If you are not ready for that move just yet, you can calculate how many calories you expend per day with the following charts below.

## Basal Metabolic Rate – BMR

Your BMR is the minimum caloric requirement needed to sustain life in a resting individual. This is the total amount of energy (calories) you would burn if you slept all day. Calories are burnt with blood circulation, respiration and daily maintenance of body temperature. BMR is the first measurement needed to understand how much energy or calories your

body burns per day. As with any chart or formula there are variables that affect your BMR.

- **Age** – The younger you are the higher your BMR, after 20 years your BMR can drop due to less lean body mass.
- **Gender** – Men have more lean body mass, thus a higher BMR
- **Genetics** – Some individuals have faster metabolisms
- **Body Fat %** - The higher the body fat, the lower the BMR
- **Height** – Taller people have higher BMR
- **Hormones** – The higher the thyroxin, the greater the BMR
- **Severe Dieting** – Intense caloric reduction or starvation can reduce BMR
- **Internal / External Temperatures** – Higher internal temperature raises BMR, as well as colder temperature outside the body

## Calculations of BMR

### *General Calculation*

Body weight (lbs.) x 10kcal/lb = BMR  
200lbs x 10 = 2000 calories per day

### *More Accurate Calculation (The Harris-Benedict Equation)*

Males:  $66 + (13.7 \times \text{weight in kg}) + (5 \times \text{height in cm}) - (6.8 \times \text{age}) = \text{BMR}$   
Females:  $655 + (9.6 \times \text{weight in kg}) + (1.7 \times \text{height in cm}) - (4.7 \times \text{age}) = \text{BMR}$

### *Most Accurate Calculation (The Katch-McArdle Equation)*

Male & Female:  $370 + (21.6 \times \text{lean body mass in kg}) = \text{BMR}$   
\*Body composition testing is needed to determine lean body mass

Once you have determined your BMR, you then multiply your BMR by your daily activity caloric burn. Below you will find a simple chart to follow:

## Activity Multiplier:

- **Sedentary** = BMR X 1.2 (little or no exercise, desk job)
- **Lightly active** = BMR X 1.375 (light exercise/sports 1-3 days/wk)
- **Moderate active** = BMR X 1.55 (moderate exercise/sports 3-5 days/wk)
- **Very active** = BMR X 1.725 (hard exercise/sports 6-7 days/wk)
- **Extremely active** = BMR X 1.9 (hard daily exercise/sports & physical job or 2X day training, i.e. marathon, contest etc.)

## Example:

2000 calorie BMR with light activity

$2000 \times 1.375 = 2750$  calories per day

## What is Your Goal?

Utilizing the above example and taking the Law of Thermodynamics we can identify how many calories we need to consume per day. If the goal is to lose body weight, we must then consume less than 2750 calories per day. Science has indicated that a safe weight loss per week for average genetic person is one pound. One pound stores 3500 calories of energy, so to lose one pound a week we must have a caloric deficit of 500 calories per day. Based on our formula the individual would consume 2250 calories per day in order to achieve their goal.

It is important to remember that when utilizing formulas there is always a chance of error. If the individual is not losing weight, and is 100% accurate with their daily caloric intake then a further reduction in calories is needed.

## If 500 Calories Work Why Not More?

Severe caloric reduction leads to a slower metabolism, decrease in thyroid output, decrease in mental clarity, and a decrease in muscle mass. A safe guideline is to follow a 500 caloric reduction daily if your goal is weight loss, with 1000 calories as a maximum reduction. Health professionals recommend a man not lower daily calories less than 1800 and a female 1200. If you have access to body composition testing you can monitor lean body mass numbers to ensure there is no muscle loss. Our example was for weight loss, although the same formula works for weight gain. If an individual is burning 2750 calories daily and wants an increase in muscle they need to increase calories. The 500-calorie guideline is a great place to start, thus the calories consumed would need to be 3250 daily.

