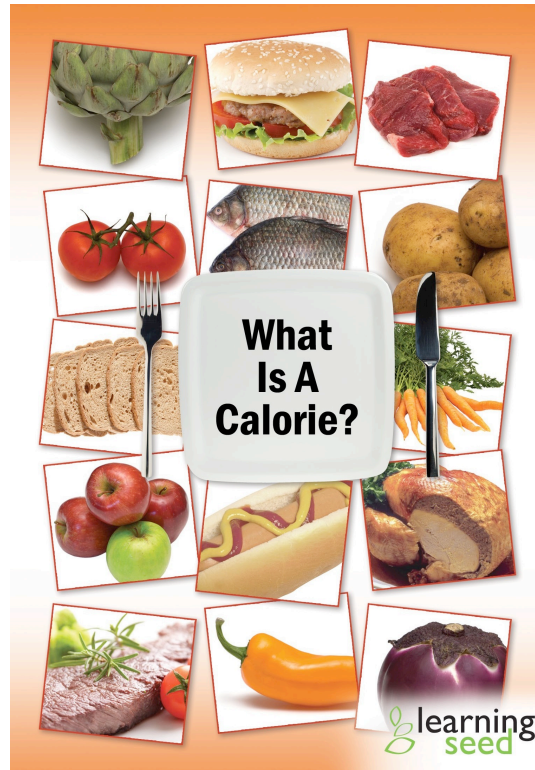


What Is A Calorie?



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Closed Captioning

This program is closed-captioned.

What Is A Calorie?

What is a calorie?

What does a calorie look like?

How do you count them?

Well, first, a Calorie isn't a "thing." It's a measurement. So asking what a Calorie looks like is like asking "What's an inch look like?" or "What shape is a kilogram?"

You can measure the energy, or calories, of prairie grass or oil or lots of things, but when most folks use "calories" they are talking about energy in food.

Take charcoal, for example. You could say charcoal has lots of calories. Meaning, it's an excellent source of heat energy. You could say paper "has fewer calories" than charcoal. It would take an armful of Sunday newspapers to equal the heat from a few pieces of charcoal. But paper does have heat energy – it "has calories." And the Sunday paper has more calories than the daily edition.

A hamburger on the grill teaches us about calories. When the fat drips, the hot charcoals flame up; this is a release of energy. Thus, fat is calorie rich. When a piece of lettuce is placed on the charcoals, little happens, indicating that lettuce is not calorie rich.

How Big Is A Calorie?

How much energy is one food Calorie? A Calorie is the heat needed to raise the temperature of a kilogram of water (that's a little over a quart), one degree Celsius. When you put two tablespoons of sugar in coffee, you're stirring in about 100 Calories of energy. A hundred Calories can raise the temperature of over 4 cups of ice from freezing to boiling — if all the sugar's energy is converted to heat.

Food contains a surprising amount of energy. And we need a lot of energy to live. The energy in one peanut is ...1.8 food Calories. That doesn't sound like much, but a single food Calorie can be converted into enough work to lift an adult human two stories into the air!

And, believe it or not, a candy bar has enough energy to lift an average size adult 1,200 feet up in the air – right to the top of Yosemite's El Capitan. That's more energy than a stick of dynamite! But a candy bar doesn't explode – it releases energy slowly, not with a bang. Also, you convert less than 20 percent of its energy into work. That's why you can't climb a mountain on a single candy bar. And a candy bar won't "blow you up."

See *"The power of a Calorie"* and *"Does the candy bar really explode?"* in *Items for Discussion*

How Do We Measure Calories?

How do we know how many calories food contains? Easy – we blow up the food! Scientists use a device called a bomb calorimeter. They put the dried food in it and incinerate it (burn it) in an oxygen rich environment. OK, so it doesn't really explode, but it does transfer its energy to a carefully measured amount of water. And the change in water temperature reveals how much energy is in the food.

Our bodies are not as efficient as a calorimeter, so when we burn a gram of carbohydrate or protein in our bodies we get 4 Calories. A gram of fat yields 9 Calories. Remember those numbers. That's about 100 calories an ounce for carbs or protein and 230 an ounce for fat.

In a sense, you never know exactly how many calories you consume. To measure the food's energy you have to burn it – so you can't eat it. We can only measure other foods that are LIKE the ones we eat. That's one reason calorie counts on food packages are only approximations. This ice cream shows 130 calories. But it could range from 104 to 156 if tested.

How Many Calories Do You Need?

So how much energy do you need daily? If you are young and moderately active, you can figure 15 Calories per pound to keep that weight steady

What do you do with all that energy? You use 80% of it to keep your body heated to 98.6 degrees. The other 20% goes for movement and chemical reactions.

Sometimes we talk about eating as “fueling up.” The comparison has some truth, but don't take it too far. When a car is at rest it uses no fuel. But people use fuel 100% of the time; even when “parked.”

Plus, we use food to re-build our bodies completely every few years. Very little of your body today existed five years ago. These activities are part of “staying alive” -- we call it basal metabolism.

You can figure how many calories you need to exist -- your own basal metabolic rate (called BMR). Females can multiply their weight in pounds by eleven. So a 120 pound woman has a BMR of 1,320 Calories a day; that's 120 times eleven.

Males can multiply their weight by twelve. A 160 pound male would have a BMR of 1,920 calories a day; that's 160 times twelve. Your BMR shows about how many Calories you need daily if you merely stay in bed all day.

We need fewer calories as we age. So, for each decade over 20, reduce your calculated BMR by 2%. That means a 60 year old woman needs about 200 fewer calories a day than a 30 year old woman of the same size.

There's another catch with calories. The less you weigh, the fewer calories you need to stay at that weight. Why? It takes more energy to move more weight and to heat a larger body. That's one reason dieting is so tough. The more weight you lose, the less food you need. The first pounds ARE the easiest to lose.

Calories And Weight

What do Calories have to do with weight? Physics tells us we can't destroy energy. You either use the energy or store it. Humans store excess energy as fat. All the miracle diets in the world can't change the laws of physics.

Each pound of fatty tissue can store 3,500 Calories. So, 3,500 unused Calories equals about an extra pound of fat.

Dieting is usually not enough to lose extra fat. When your body senses a lack of food, it becomes more efficient and stores energy to make up for the shortfall.

Permanent weight loss usually involves BOTH a decrease in calories and an increase in activity. To lose a pound in a week by activity alone requires adding a brisk two hour walk EVERY DAY!

The term "empty calories" makes about as much sense as an "empty inch." But it means calories without vitamins, minerals, or other nutrients. Most diets have only a little room for such foods. Sugar is nearly pure energy -- very little else. So is alcohol. Fats like cooking oil and shortening are empty of nutrients.

Fact Sheet: What Is a Calorie?

A calorie is an energy measure. One food Calorie is the energy needed to raise the temperature of one kilogram of water (a little over a quart), one degree Centigrade.

The United States uses “calorie” to mean the same as what other countries call a “kilocalorie.” We use a capital C in Calorie to show it is a food calorie, which is actually 1,000 calories with a small c. So a Calorie is really 1,000 calories.

Food has lots of energy. A candy bar has enough energy to lift an adult 1,200 feet into the air. 3,000 Calories is equal to the energy in six pounds of TNT.

There are two ways to measure food Calories. The most accurate is to use a bomb calorimeter. A sample of the food is burned in an oxygen-rich environment. The second way is to estimate Calories based on the how much fat, protein, and carbohydrate the food contains. Each gram of protein and carbohydrate yields about 4 calories, and each gram of fat 9. This “4-4-9” rule is a common way to estimate calories.

Your basal metabolism is the energy you use just to survive – to breathe, think, pump blood, warm your body, etc. Multiply your weight by 11 (women) or 12 (men) as an estimate of your basal metabolic rate (or BMR). For each decade over 20, reduce the BMR by 2%. 80% of the energy you eat is used to keep your body warm.

Your BMR plus Calories you burn in activity gives an estimate of the calories you need to maintain your current weight. Your body stores energy it does not use as fat to the tune of 3,500 calories for a pound of body fat.

Calorie Costs

In addition to the energy you need just to keep your body working, you also need energy for all physical activities. You need more calories to play tennis for ten minutes than to read a book for the same length of time.

The figures below show an estimate of the number of calories it takes to do various activities. A range is given for each. The lower end is the best estimate for small persons (small frame and low weight), and the upper end for larger persons. Men usually require more calories for activity than women, in part because they have a more muscular body.

80-100 Calories per hour (reading, watching TV, working on a computer)

110-160 Calories per hour for light activities such as walking slowly (strolling)

170-240 Calories per hour for moderate activities such as walking, table tennis

250-350 Calories per hour for Vigorous activities such as walking at a brisk pace, golfing without a cart, gardening

350 Calories or more per hour for swimming, active tennis, running, dancing, skiing, soccer.

Calories, Peanuts and Dynamite

In *What Is a Calorie?* we show that a peanut contains enough energy to lift an adult two stories into the air. How can this be?

We do NOT suggest you try to duplicate this experiment. The peanut oil burns for a surprisingly long time and the oil can fall from the peanut while still burning. We did the experiment done over a pan of water with a fire extinguisher nearby.

The burning peanut yielded 1880 calories. But these are the calories used in physics. A food Calorie is actually 1000 of these calories. So 1880 calories is 1.8 food Calories. A food Calorie is a kilocalorie.

Translating into joules, we see the energy can lift a 155 person about six meters. To work off the 1.8 Calories, a 155 lb. person would have to climb to the top of a four story building.

To complicate the example, a peanut yields more than 1.8 Calories when you eat it. Burning a peanut under a tube of water is not a direct simulation of how the body captures energy. A lot of the energy in the peanut is lost to the air. Our bodies “burn” the peanut slowly and more efficiently to produce five or six Calories.

A 200 Calorie candy bar contains more energy than a stick of dynamite. 200 food Calories is 200,000 physicist calories or nearly a megajoule of energy — enough to lift an average adult over 3,900 feet into the air. In fact, an ounce of dynamite produces only one-quarter as many calories when it explodes as an ounce of sugar does when it burns. But we don’t blow things up with sugar because the sugar energy is released over time and the dynamite gives up its energy in an instant.

Formulas

Heat Calculation:

Q=heat flow

m=mass of the water

c=heat of the water

▲T=temperature change

$$Q=mc\Delta T$$

Calories in 1 gram of carbohydrate, protein, fat

1 gram of carbohydrate or protein = 4 Calories

1 gram of fat = 9 Calories

How many Calories do you need to keep your weight steady?

You need 15 Calories per pound:

Your weight x 15 = the number of calories you need

BMR

Females: your weight x 11 = your BMR

Males: your weight x 12 = your BMR

Age and BMR: for every decade over 20, reduce your calculated BMR by 2%

Unused Calories

3,500 unused Calories = 1 pound of fat

Items For Discussion

I. The power of a Calorie

Many viewers will be skeptical of these claims for the power of a Calorie. Here is a scientific explanation for the measurements given in the video:

First, realize that a food calorie is really a kilocalorie (that's how they are shown on food packages in other English speaking countries), or 1,000 calories. We capitalize food Calorie to show it is really a kilocalorie or 1000 "physicist" calories. One calorie converts to 4200 joules. One joule of energy will lift a tenth of a kilogram, (a quarter pound) one meter in the air. So one Calorie or 4200 joules will lift a 70 kilogram (155 pound) person six meters into the air. To work off the 1.8 Calories from one peanut a dieter will have to climb to the top of a four-story high building.

Calorimetry reveals that a 200 Calorie candy bar contains more energy than a stick of dynamite. Remember that 200 food Calories is 200,000 physicist calories or about 840,000 joules! Nearly a megajoule! A megajoule of energy can perform enough work to lift an average 70-kilogram human being 1200 meters in the air. In fact, an ounce of dynamite produces only one-quarter as many calories when it explodes as an ounce of sugar does when it burns.

2. Does the candy bar really explode?

Background for the science student: When a peanut or a candy bar burns, chemical bonds in their molecules break under the high temperatures of combustion, and then combine with oxygen from the air in a reaction called oxidation. In this reaction, fats and carbohydrates are converted to carbon dioxide (CO₂) and water (H₂O). The oxygen bonds in these compounds have lower energy than the original bonds holding together the fat and carbohydrate molecules. The difference in energy is released into the air as heat flow. Your body oxidizes the peanut (it doesn't really set it on fire) to release energy and produce carbon dioxide and water. The peanut releases the same amount of energy when it is oxidized in the body as when it is burned. Your body oxidizes the peanut with a low temperature process which is more complicated than the reactions that occur in a fire.

Suggested Activities

Make your Calories Count: Use the Nutrition Facts Label for Healthy Weight Management

Have your students visit the U.S. Food and Drug Administration website and complete the Make your Calories Count interactive program.

Website: <http://www.cfsan.fda.gov/~ear/hwm/labelman.html>

How Many Calories do YOU Need?

In 2002 the national Academy of Sciences released a formula for estimating how many calories adults need to maintain their weight. Note that this is not a suggestion for how many calories you should eat. If you are overweight, the number of calories suggested by this formula will keep you overweight. In other words, this “calorie target” gives an idea of what you need to eat to keep from gaining weight

If you want to lose weight, calculate a new calorie target using how much you *want* to weight in step three. Subtract the new calorie target from the current one to show approximately how many Calories you need to cut daily to reach your new weight goal.

Note that this calorie target is for adults, not for those still growing.

What is Your Activity Level?

Which of these best describes your daily activity level?

	Brisk walking or swimming	Cycling or aerobics	Jogging	Activity level men	Activity level women
Sedentary	Less than 30 minutes	Less than 22 minutes	Less than 11 minutes	1.0	1.0
Low Active	30 minutes	22 minutes	11 minutes	1.14	1.12
Active	105 minutes	80 minutes	40 minutes	1.27	1.27
Very Active	4 hours	3 hours	90 minutes	1.45	1.54

Formulas

Women

- A. Multiply your age by 7.31 _____
- B. Subtract (A) from 387 _____ (if you're over 52 this can be a negative number)
- C. Multiply your weight in pounds by 4.95 _____
- D. Multiply your height in inches by 16.78 _____
- E. Add C + D _____
- F. Multiply E (that's C+D) by your activity level from the "How Active are You" chart above _____
- G. Add B and F _____

Men

- A. Multiply your age by 9.72 _____
- B. Subtract A from 864 _____
- C. Multiply your weight in pounds by 6.46 _____
- D. Multiply your height in inches by 12.8 _____
- E. Add C and D _____
- F. Multiply E by your activity level from the "How Active Are You" chart above _____
- G. Add B and F _____

What Is A Calorie?

Video Worksheet

1. A Calorie is
 - a. A measurement
 - b. Energy in food
 - c. Both
2. You can see a Calorie. True or False
3. How does a hamburger on a grill illustrate a calorie?
4. A Calorie is the _____ needed to raise the _____ of a _____ of water _____ degree _____.
5. Scientists use a device called a _____ to measure Calories in food.
6. A gram of carbohydrate or protein = _____ Calories
7. A gram of fat = _____ Calories
8. Calorie counts on food packages are:
 - a. Exact
 - b. Approximations
 - c. Inaccurate
9. A kilocalorie (kcal) is the same as:
 - a. a gram of fat
 - b. kilojoule
 - c. a food Calorie
 - d. the Calories found in a head of lettuce
10. You use _____ of your energy to keep your body heated to _____ and _____ for movement and _____.
11. To calculate a woman's BMR, multiply her weight by _____.
12. Larger people need more Calories. True or False
13. Calories have absolutely nothing to do with weight. True or False
14. Each pound of fatty tissue can store _____ Calories.
15. Dieting is enough to lose extra fat. True or False

What Is A Calorie?

Video Worksheet

1. A Calorie is
 - a. 1000 calories
 - b. 1000 kilocalories
 - c. Both
2. You can see a Calorie. False
3. How does a hamburger on a grill illustrate a calorie?

When the fat drips, the hot charcoals flame up; this is a release of energy. Thus, fat is calorie rich.

4. A Calorie is the heat needed to raise the temperature of a kilogram of water one degree Celsius.
5. Scientists use a device called a bomb calorimeter to measure Calories in food.
6. A gram of carbohydrate or protein = 4 Calories
7. A gram of fat = 9 Calories
8. Calorie counts on food packages are:
 - a. Exact
 - b. Approximations
9. A kilocalorie (kcal) is the same as:
 - a. 1000 calories
 - b. 1000 kilocalories
 - c. a food Calorie
10. You use 80% of your energy to keep your body heated to 98.6 degrees and 20% for movement and chemical reactions.
11. To calculate a woman's BMR, multiply her weight by 11
12. Larger people need more Calories. True
13. Calories have absolutely nothing to do with weight. False
14. Each pound of fatty tissue can store 3,500 Calories.
15. Dieting is enough to lose extra fat. False

What is a Calorie?

Vocabulary Worksheet

Match the words in the first column to the best available answer in the second column.

_____ a unit in nutrition equivalent to 0.239 calorie

1) Bomb calorimeter

_____ 3,500 unused Calories

2) Calorie

_____ the rate at which heat is given off by an organism at complete rest

3) Kilocalorie (kcal)

_____ equivalent to a food Calorie

4) 1 pound of fat

_____ the turnover of energy in a fasting and resting organism using energy solely to maintain vital cellular activity, respiration, and circulation as measured by the basal metabolic rate

5) Kilojoule

_____ calorie from food that supplies energy but is not nutritionally balanced

6) 4 Calories

_____ an apparatus for measuring quantities of absorbed or emitted heat or for determining specific heats

7) Empty calorie

_____ the heat needed to raise the temperature of a kilogram of water 1 degree Celsius

8) Basal metabolic rate (BMR)

_____ 1 gram of fat

9) Basal Metabolism

_____ 1 gram of carbohydrate or protein

10) 9 Calories

What Is A Calorie?

Vocabulary Worksheet Answer Key

Match the words in the first column to the best available answer in the second column.

- | | |
|-------------------------------|--|
| 5) Kilojoule | a unit in nutrition equivalent to 0.239 calorie |
| 4) 1 pound of fat | 3,500 unused Calories |
| 8) Basal metabolic rate (BMR) | the rate at which heat is given off by an organism at complete rest |
| 3) Kilocalorie (kcal) | equivalent to a food Calorie |
| 9) Basal Metabolism | the turnover of energy in a fasting and resting organism using energy solely to maintain vital cellular activity, respiration, and circulation as measured by the basal metabolic rate |
| 7) Empty calorie | calorie from food that supplies energy but is not nutritionally balanced |
| 1) Bomb calorimeter | an apparatus for measuring quantities of absorbed or emitted heat or for determining specific heats |
| 2) Calorie | the heat needed to raise the temperature of a kilogram of water 1 degree Celsius |
| 10) 9 Calories | 1 gram of fat |
| 6) 4 Calories | 1 gram of carbohydrate or protein |

What Is A Calorie?

Calorie Quiz

1. The word “calories” refers to the ability of a food to produce what?
2. One Calorie is the heat needed to raise the temperature of a kilogram of water by how many degrees Celsius?
3. Which has more calories? A head of lettuce or the Sunday newspaper?
4. What is the name of the device scientists use to measure the calorie value of a food sample?
5. A gram of protein or carbohydrate yields about 4 calories. How many calories will a gram of fat yield?
6. True or False? A so-called “empty calorie” is one that contains very little food energy.
7. You use about 80% of the calories you eat for what activity?
8. If you jog for about thirty minutes, you burn how many calories
(a) 150, (b) 30 times your weight, (c) it depends on how much you weight, (d) approximately 750.
9. About how many “unused” calories are stored in one pound of body fat?
10. Extra energy gained from food that the body does not use is stored. What is the body’s main means of storing energy for long times?
11. You see on a food label that a serving of a food has 5 grams of protein, 9 grams of carbohydrate and 2 grams of fat. About how many calories does a serving of the food contain?
12. Which of these food groups is usually the highest in Calorie value? (a) sugars and sweets, (b) soft drinks, (c) fats and oils, (d) meat and steak.
13. If you are moderately active, about how many Calories per pound of body weight do you need to maintain your weight? (a) 5 Calories a pound, (b) 15 Calories a pound, (c) 30 Calories per pound, (d) 100 Calories per pound.
14. What most likely causes weight gain? (a) Eating lots of carbs, (b) eating lots of high energy protein, (c) eating calories that are not burned, (d) eating over 2,500 Calories daily, (e) all of these.

What Is A Calorie?

Calorie Quiz Answer Key

1. energy
2. one
3. newspaper
4. calorimeter or bomb calorimeter
5. nine
6. false
7. maintain body heat
8. C it depends on how much you weigh
9. 3,500
10. fat
11. 74 calories. $5 \times 4 = 20$ (each gram of protein yields four calories), plus $9 \times 4 = 36$ (each gram of carbohydrate yields four calories), plus $2 \times 9 = 18$ (each gram of fat yields 9 calories). $20 + 36 + 18 = 74$ calories.
12. C fats and oils
13. D 15 Calories a pound
14. C extra calories cause weight gain

Glossary

Basal metabolic rate (BMR)

the rate at which heat is given off by an organism at complete rest

Basal Metabolism

the turnover of energy in a fasting and resting organism using energy solely to maintain vital cellular activity, respiration, and circulation as measured by the basal metabolic rate

Bomb calorimeter

an apparatus for measuring quantities of absorbed or emitted heat or for determining specific heats

Calorie

the heat needed to raise the temperature of a kilogram of water 1 degree Celsius

Carbohydrate

any of various neutral compounds of carbon, hydrogen, and oxygen (as sugars, starches and celluloses) most of which are formed by green plants and which constitute a major of class of animal foods

Empty calorie

calorie from food that supplies energy but is not nutritionally balanced

Fat

1: animal tissue consisting chiefly of cells distended with greasy or oily matter

2 a: oily or greasy matter making up the bulk of adipose tissue and often abundant in seeds

2 b: any of various compounds of carbon, hydrogen, and oxygen that are glycerides of fatty acids, are the chief constituents of plant and animal fat, are a major class of energy-rich foods, and are soluble in organic solvents by not in water

2 c: a solid or semisolid fat as distinguished from an oil.

Kilocalorie (kcal)

equivalent to a food Calorie

Kilojoule

a unit in nutrition equivalent to 0.239 calorie

Protein

1. any various naturally occurring extremely complex substance that consist of amino-acid residues joined by peptide bonds, contain the elements carbon, hydrogen, nitrogen, oxygen, usually sulfur, and occasionally other elements (as phosphorus or iron), and include many essential biological compounds (as enzymes, hormones, or antibodies)

2. the total nitrogenous material in plant or animal substances

For More Information...

Visit the Mayo Clinic Website

- Low-Fat foods: Not always Low Calorie?
<http://www.mayoclinic.com/health/low-fat/HQ01663>
- Energy Density and Weight Loss: Feel Full on Fewer Calories
<http://www.mayoclinic.com/health/weight-loss/NU00195>
- Exercise: Calories Burned in 1 Hour of Exercise
<http://www.mayoclinic.com/health/exercise/SM00109>

Visit the U.S. Food and Drug Administration Website

- Losing Weight: Start by Counting Calories
http://www.fda.gov/fdac/features/2002/102_fat.html
- Make Your Calories Count: Use the Nutrition Facts Label for Healthy Weight Management
<http://www.cfsan.fda.gov/~ear/hwm/labelman.html>