



Eating for Health and Performance: *The Wildland Firefighter*

This brochure will help firefighters balance food intake with energy demands before, during, and after the fire season.



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Part I Energy for Work: Calories

Firefighting is a physically demanding occupation that may require 6,000 calories (kilocalories) per day. Firefighters who do not consume enough calories will become fatigued and lose body weight and muscle. Consuming too few calories over the weeks and months of a busy fire season can impair immune function and lead to illness. This is not the time to lose weight. Firefighters should check their weight every 2 weeks to monitor their energy balance. The best time to weigh is in the morning before breakfast (but after urination). Energy (calories) comes from carbohydrate, fat, and protein.

Carbohydrate

Carbohydrate is converted to glucose and stored in liver and muscle as glycogen (branched chains of glucose molecules). Muscle glycogen fuels the muscles during work; liver glycogen maintains blood glucose, the **primary fuel for the brain and nervous system**. When blood glucose levels drop due to extended physical activity, carbohydrates from the food we eat can be used to produce blood glucose. If the body does not receive enough carbohydrate through the diet, it will make glucose from muscle protein, a poor alternative because the muscle protein is needed for the work at hand.

Carbohydrate Requirements

High levels of continuous physical activity, such as digging fireline for hours, increase the daily carbohydrate requirements. Each gram of carbohydrate provides 4 calories of energy.

The following example shows how to calculate the carbohydrate requirement for a 154-pound firefighter:
Weight (in pounds) 154 / (2.2 pounds/kilogram) = 70 (weight in kilograms)

Moderate Work—5 to 7 grams of carbohydrate/kilogram/day x 70 kilograms (body weight) = 350 to 490 grams of carbohydrate/day

Hard Work—7 to 10 grams of carbohydrate/kilogram/day x 70 kilograms (body weight) = 490 to 700 grams of carbohydrate/day

For ultraendurance activities or very hard work, such as a long, hard day on the fireline, the carbohydrate requirement could be even higher.

Carbohydrate-rich foods include whole-grain products, beans, rice, corn, peas, potatoes, fruit, fruit juice, milk, yogurt, energy bars, and most sport drinks.

Food	Carbohydrate Content (grams)
1 slice bread	12
1 cup beans	48
1 cup rice	37
1 cup corn	41
1 medium apple	21
1 energy bar	25
1 cup sports drink	15
1 cup milk	12
1 cup yogurt	14 to 44

During work, firefighters need 40 grams of carbohydrate each hour from snacks and sport drinks. An energy bar may contain 25 grams of carbohydrate, and 1 cup of a sports drink may contain 15 grams, for a total of 40 grams of carbohydrate. Field studies on firefighters show that *eating carbohydrate improves* work output, immune function, blood glucose, ability to think clearly, and mood.

Fat

Fat should provide no more than 20 to 35 percent of daily calories. No more than one-third of the fat should come from saturated and trans fats (such as butter, lard, dairy fat, and some processed fats—read the labels). The balance of fat should come from monounsaturated and polyunsaturated fats (such as olive, canola, and peanut oils or from nuts such as almonds, hazelnuts, and olives). If a firefighter needs 4,000 calories per day for heavy work, one-quarter can come from fat (1,000 calories). Because each gram of fat has 9 calories, that's 111 grams (4 ounces) of fat per day.

Protein

Athletes and wildland firefighters require **1.2 to 1.8** grams of protein per kilogram of body weight per day, with **1.2** grams required for moderate work and **1.8** grams required for prolonged hard work under adverse conditions. For this example, we will use a 154-pound (70-kilogram) firefighter who requires **1.5** grams of protein each day for each kilogram of body weight.

1.5 grams of protein/kilogram/day x 70 kilograms (body weight) = 105 grams (3.7 ounces) of protein/day.

Protein in Foods

Food	Portion	Grams of Protein
Almonds	¼ cup	5
Beans	½ cup cooked	8
Beef	4 ounces	35
Cheese	1 ounce	7
Chicken	4 ounces no skin	37
Chili	1 cup	20
Corn	½ cup cooked	3
Egg	1	6
Fish	4 ounces	31
Hamburger patty	4 ounces	20
Milk	1 cup	8
Peanut butter	1 tablespoon	4
Pizza	1 slice	10
Pork	4 ounces lean	35
Rice	½ cup cooked	2.5
Sunflower seeds	¼ cup	8
Tofu	1 cup	6 to 9
Veggie burger	4 ounces	5

Shift Food—Eating throughout the shift maintains blood glucose and work output.



A firefighter sorts the day's shift food during a field study.

Part II Nutrients and Hydration

Nutrition Needs: Determine your caloric and nutrient needs by using the Web site <http://www.mypyramid.gov>. Enter your age, gender, and level of physical activity. The site will provide daily nutrition requirements, but remember that the protein and carbohydrate requirements underestimate the needs of wildland firefighters, who are more physically active. Click on the food group for additional information. The following table illustrates the requirements for light and arduous work.

A firefighter should consume:

	Light work (2,200 calories)	Arduous work (4,400 calories)
Fruit	4 servings (2 cups)	12 servings (6 cups)
Vegetables	4 to 5 servings (2 to 2½ cups)	8 servings (4 cups)
Whole grains*	6 servings	12+ servings
Milk or yogurt	1 to 2 cups	5 cups
Meat, fish**	6 ounces	10 ounces

*Whole grains and enriched or whole-grain products.

**Meat, fish, or meat substitute.

Firefighters do not need vitamin and mineral supplements if their diets include a variety of nutrient-rich foods and beverages and provide enough energy to maintain their body weight.

For information on vitamin and mineral needs, see *Wildland Firefighter Health and Safety Report: No. 9* on the MTDC Web site (see page 7).

Hydration

Fluid requirements vary from person to person and change with environmental stress. Wildland firefighters should drink enough water throughout the day so they don't lose more than 2 percent of their weight while working. The U.S. Army and American College of Sports Medicine recommend drinking 1 liter of fluid for every hour of hard work to maintain blood volume and the body's ability to cool itself by sweating.

The work of wildland firefighting generates about 400 calories of heat per hour, while the firefighter receives another 180 calories of heat from the environment and the fire ($400 + 180 = 580$ calories of heat gain/hour). Complete evaporation of 1 liter of sweat will remove those 580 calories of heat.

Sweat rate and fluid loss differ among individuals. Urine color is a reasonably accurate gauge of hydration—urine should remain pale yellow or wheat colored throughout the day. Daily fluctuations in weight can be monitored to track hydration (weigh in the morning after urination but before eating or drinking).

Hydrate before work	Drink 1 to 2 cups of fluid
Hydrate during work	Drink 1 cup of fluid every 15 minutes (1 quart/hour)
Hydrate after work	Drink 2½ cups of fluid for each pound of weight lost.

For more information on heat and hydration, see *Wildland Firefighter Health and Safety Report: No. 3 or Fitness and Work Capacity* (1997) on the MTDC Web site (see page 7).

Electrolytes

Electrolytes are minerals (sodium and potassium) that are important for nerve/muscle function, and for the body's fluid and acid/base balances.

To replace electrolytes lost in sweat:

- Use the salt shaker at meals
- Eat salty foods (pickles, olives, jerky) during hard work
- Drink carbohydrate/electrolyte drinks (sport drinks) during hard work
- Drink milk at breakfast or after work

Sport Drinks

Carbohydrate/electrolyte drinks (sport drinks) help maintain blood glucose, work output, immune function, mood, and the ability to make decisions. The electrolytes help to maintain blood volume and reduce loss of fluid in the urine. Lightly flavored sport drinks encourage drinking. For more information on sport drinks, see *Wildland Firefighter Health and Safety Report: No. 8* on the MTDC Web site.



Mix sports drinks to taste in the field.

Part III Related Issues

Immune Function

Psychological stress, exhaustion, smoke exposure, sleep deprivation, and dehydration can degrade immune function. A well-balanced diet with adequate calories, meat, shellfish, fruits, and vegetables enhances immunity. Research has demonstrated that eating snacks and drinking sport drinks to provide extra carbohydrates during work help to maintain the immune function of wildland firefighters.

Incident Management Teams

Incident management team members do less arduous work than wildland firefighters. Their dietary needs are based on the daily energy expenditure required to maintain the body mass index (BMI) in the normal range (20 to 24.9). Use <http://www.mypyramid.gov> to determine your nutritional needs. The BMI chart is at <http://www.cdc.gov/nccdphp/dnpa/bmi/>.

Weight Management

When fire season is over, eat less because your energy needs will be lower. To lose weight during the off season:

- Increase physical activity
- Decrease caloric intake by
 - Decreasing intake of sweets and fats
 - Decreasing portions of all foods

Weigh yourself every 2 weeks to monitor your progress.

Begin the fire season **physically fit with a sound nutritional base.**

Carla Cox, Ph.D., R.D. Carla.Cox@mso.umt.edu
Brian Sharkey, Ph.D. bsharkey@fs.fed.us

Additional copies of this document may be ordered from:

USDA Forest Service, Missoula Technology and Development Center
 5785 Hwy. 10 West
 Missoula, MT 59808-9361
 Phone: 406-329-3978
 Fax: 406-329-3719
 E-mail: wo_mtdc_pubs@fs.fed.us

For additional information about eating for health and performance, contact Brian Sharkey at MTDC.

Phone: 406-329-3989
 Fax: 406-329-3719
 E-mail: bsharkey@fs.fed.us

Electronic copies of MTDC's documents are available on the Internet at:

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Forest Service and Bureau of Land Management employees can search a more complete collection of MTDC's documents, videos, and CDs on their internal computer networks at:

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