

# Wildland Firefighter

## Health & Safety Report

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Missoula Technology and Development Center

No. 11

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### Background

This report, the 11th in a series, reviews activities related to the Missoula Technology and Development Center's (MTDC) project on wildland firefighter health and safety. The project focuses on three areas:

- Work, rest, and fatigue: Determine work/rest guidelines, assignment length, and fatigue countermeasures for crews and overhead.
- Energy and nutrition: Improve the energy intake, nutrition, hydration, immune function, and health of wildland firefighters.
- Fitness and work capacity: Use work capacity and medical standards to ensure the health, safety, and productivity of wildland firefighters.

### Intermittent Feeding

With the help of cooperators from the University of Montana Human Performance Laboratory, MTDC measured the energy expenditure of wildland firefighters and examined fire camp meals for energy and nutrients. Energy and nutrient requirements of firefighters will be met so long as firefighters eat a variety of foods and increase energy intake to match caloric expenditure. Dietary recommendations were published in an MTDC tech tip, *Feeding the Wildland Firefighter* (2002, 0251-2323-MTDC).



Firefighters select shift food during an MTDC/University of Montana field study. The shift food group performed more work than the sack lunch group, even though both groups consumed the same amount of energy.

**Intermittent feeding throughout the shift maintains blood glucose and work output.**

We have also studied the value of carbohydrate supplementation and intermittent feeding throughout the work shift as ways to maintain work output. These studies and work with the U.S. Army Research Institute for Environmental Medicine led to a recommendation to consider shift food as an alternative to the traditional sack lunch. Shift food is individually packaged, snack-size food items that are eaten intermittently throughout the shift to maintain blood glucose and work output. Intermittent feeding also helps maintain immune function, a positive mood, and could improve decisionmaking and safety. The Featured Topic section in this issue examines shift food.

The Research section summarizes findings from studies conducted on firefighters during the 2006 fire season. The Risk Management section introduces a nutrition education program designed for wildland firefighters and incident management team members: *Eating for Health and Performance: The Wildland Firefighter*. The program includes a PowerPoint presentation, a brochure, and an instructor's guide. The Field Notes section, based on a summer field study, includes advice on cleaning a water bottle or a sipping hydration system that includes a bladder and tubing.



Firefighters eating shift food performed 41 percent more work late in the shift.

## Featured Topic



### Shift Food

In cooperation with the University of Montana Human Performance Laboratory, MTDC has studied the effect of supplemental feeding strategies on self-selected work activity during wildland fire suppression. Firefighters from eight different interagency hotshot crews were studied during three fire seasons. During the first two seasons subjects consumed, in addition to a sack lunch, either a liquid carbohydrate drink or a flavored placebo every hour, or liquid carbohydrate every even hour and solid carbohydrate every odd hour, using counterbalanced crossover designs. During the third season, subjects consumed either their sack lunch halfway through their workday or shift food at 90-minute intervals after breakfast, in a randomized crossover design with similar caloric intake in sack lunch and shift food (1,500 kcal per shift). In all studies, work output was monitored using electronic activity monitors.

During the liquid carbohydrate trials, firefighters who consumed liquid carbohydrate drinks had significantly higher average activity for the entire day than those who consumed a placebo. For the liquid and solid carbohydrate trials, firefighters consuming carbohydrate had higher average activity 2 hours before lunch and during the last 4 hours of the workday, when compared to those who consumed a placebo.

For the sack lunch and shift food trials, firefighters eating shift food had higher average work activity during the final 2 hours of work when compared to those eating sack lunches. Liquid and/or solid supplemental carbohydrate and intermittent feedings rather than a single meal increased self-selected work rates during fire suppression, particularly late in the workday. Shift food items purchased at local grocery stores cost less than the sack lunch.

In related studies conducted in cooperation with the Army Research Institute of Environmental Medicine, we studied the effect of an experimental ration consisting of eat-on-the-move items to promote snacking and provide caffeine during fire suppression activity. The eat-on-the-move ration, also known as a First Strike ration (FSR) (3,067 kcal/day) was compared to a Meal, Ready to Eat (MRE) field ration, (2,841 kcal/day), consumed whenever the firefighters wished over several days of work. Twenty-eight wildland firefighters received each ration for 2 consecutive days, with a 1-day break between trials. Firefighters ate significantly more frequently with the eat-on-the-move ration compared to the Meal, Ready to Eat ration. Salivary caffeine and total activity counts during fire suppression were significantly higher when firefighters consumed the eat-on-the-move ration rather than the Meal, Ready to Eat ration. Researchers concluded that delivery of energy and caffeine in a manner that promotes snacking behavior (intermittent feeding) helps increase work during arduous fire suppression.

## Conclusions

Wildland firefighters are endurance athletes who engage in arduous work throughout a long work shift. Athletes in prolonged endurance events, such as the Tour de France or the Ironman Triathlon, eat at regular intervals throughout the events. Our studies reviewed in issue 10 of this report indicate that intermittent feeding of wildland firefighters throughout the work shift maintains work output, especially during the latter hours of the shift. The studies also show that intermittent feeding helps maintain blood glucose, immune function, and a positive mood. The shift food used for intermittent feeding costs less than a sack lunch, and firefighters prefer shift food to a sack lunch.

Of the meals provided in fire camp, the sack lunch is the least well received by firefighters. Alternatives to sandwiches have improved the acceptability of sack lunches. Items in the traditional sack lunch can be consumed intermittently throughout the day, but bagged sandwiches dry out once they have been opened.

## Recommendation

MTDC recommends gradual implementation of the shift food system, as an option to or replacement for sack lunches. Either approach would require developing a shift food delivery system and educational materials that emphasize intermittent feeding throughout the shift. Shift food will improve day-long work output. Maintaining blood glucose also could contribute to improved decisionmaking and employee safety. MTDC recommends a pilot program in a fire camp setting that includes a full trial with shift food and firefighter education.

The trial program would identify shift food items suitable for intermittent feeding and develop a system that ensures delivery of adequate energy and nutrients. The trial should determine firefighter acceptance of shift food. The trial also should include participation of caterers and contract personnel to ensure successful servicewide implementation.

### Shift food

#### *Intermittent feeding throughout the shift maintains blood glucose and work output.*

Firefighters select shift food in MTDC/University of Montana field study. The shift food group performed more work than the sack lunch group, even when the energy consumed was the same for both groups.



### Shift food

Firefighters consumed food throughout the day at approximately 90-min intervals. During the last 2 hours of work, the shift food group performed 41 percent more work than the sack lunch group (Cuddy and others, 2006).



Slides from the presentation *Eating for Health and Performance: The Wildland Firefighter* (see page 8).

## Research



This section reviews project-related field studies conducted on wildland firefighters during the 2006 fire season. The studies were conducted by researchers and graduate students from the University of Montana Human Performance Laboratory, in cooperation with MTDC and the U.S. Army Research Institute for Environmental Medicine with support from National Wildfire Coordinating Group.

### Shift Food or Sack Lunches?

This study evaluated the normal sack lunch and shift food items that supplied similar levels of energy. Sixty wildland firefighters from four interagency hotshot crews were studied at two different fires in the Northwest during the 2006 fire season. During 2 separate days, crewmembers consumed their traditional sack lunches whenever they wished during their work shift or shift food in a randomized crossover design. Shift food consisted of smaller food units (50 to 300 kcal) consumed intermittently throughout the day. The way in which the sack lunch or shift food was eaten during the day (all at once or throughout the day) was not controlled in the study. Total calories consumed were monitored and the amount of work performed was estimated using activity monitors. The firefighters were asked to rate their perceived exertion during the work shift and their satisfaction with each of the feeding strategies.

Subjective survey data show that firefighters prefer the shift food over the sack lunch for convenience, variety, satisfaction, appearance, and overall preference. While both groups received the same amount of energy (sack lunch, 1,666 kcal; shift food, 1,702 kcal), firefighters ate significantly more (358 kcal more) shift food than sack

lunch food. The shift food group consumed significantly more carbohydrate (1,030 kcal total) and fat (569 kcal total) (figure 1).

The shift food cost considerably less than a sack lunch (\$4.38 compared to between \$9.96 and \$12.77). There were no significant differences between the activity levels of either group during the 12-hour work shift, nor were there significant differences in perceived exertion.

Firefighters preferred shift food. There appeared to be no problems with shift food, and there were several advantages. Firefighters consumed more calories when they received shift food, indicating that less food was wasted and satisfaction was improved. The shift food should be a cost-effective approach to feeding wildland firefighters even after caterer costs are included. There were no negative impacts on self-selected work output throughout the work shift when firefighters received shift food, even though this study did not require firefighters to eat the shift food regularly during the work shift.

Earlier studies by our lab have shown that work output increased about 15 to 20 percent over the day, especially during the periods just before lunch and at the end of the day, when food was eaten at regular intervals throughout the work shift rather than at one sitting. Those data suggest that education is needed to encourage intermittent feeding throughout the work shift, similar to encouraging firefighters to drink fluids regularly to maintain their hydration. A combination of shift food and firefighter education should improve late morning and afternoon work output. The maintenance of blood glucose could improve immune function, worker safety, and decisionmaking. A full field trial including shift food and firefighter education needs to be conducted.

*The effects of shift food on work output during arduous wildfire suppression.* N. Plante, E. Lieberg, and S. Gaskill. University of Montana. Funded by MTDC.

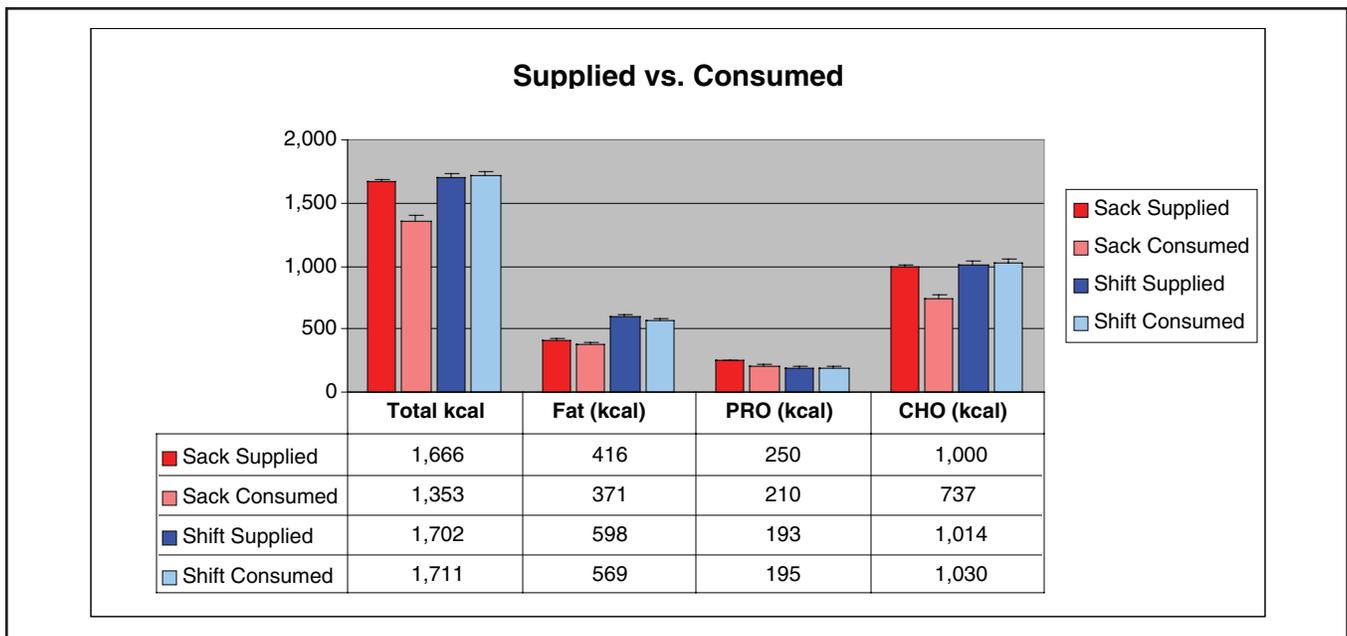


Figure 1—Wildland firefighters consume a higher percentage of their food (100 percent compared to 81 percent) when they can snack on it during the work shift. Firefighters eating shift food consumed more fat, similar amounts of protein (PRO), and more carbohydrate (CHO) calories (1,030 kcal) than they were supplied (1,014 kcal). A sport drink that had not been included in the calculations accounted for the extra kilocalories.

## First Strike Rations

The First Strike ration is compact and lightweight, designed to be consumed during short-term, high-intensity missions of about 3 days. It consists of 100 percent eat-on-the-move food items that are familiar and well liked. The study was conducted to determine whether First Strike rations sustain blood markers of metabolic and nutritional status as effectively as Meal, Ready to Eat rations over several days of arduous work. Eighteen active-duty military firefighters were randomly assigned to consume either one First Strike ration per day (2,864 kcal, 377 g carbohydrate, 91 g protein) or two Meal, Ready to Eat rations per day (2,620 kcal, 358 g carbohydrate, 84 g protein) for 3 consecutive days. Shift activity was measured by actimetry (Actical Physical Activity Monitor, Respironics Inc.). Food intake was assessed by a diet log and by inventorying eaten and uneaten food items. Venous blood was sampled after an overnight fast and at the end of the work shift on day 3. Differences between diet groups were assessed using mixed-model analysis of variance.

Workshift duration was similar between diet groups (First Strike ration: 691 min; Meal, Ready to Eat ration: 701

min). The percent of time performing moderate intensity work was similar over time and between groups (First Strike ration: 30 percent; Meal, Ready to Eat ration: 24 percent). While the percent of time performing light activity was sustained in the First Strike ration group (34±7 percent), it declined on day 3 in the Meal, Ready to Eat ration group (33±8 percent to 25±7 percent). Metabolic status markers as well as nutritional status markers changed over time, but there were no meaningful differences based on the type of ration.

The First Strike ration sustains metabolic and nutritional status as effectively as the Meal, Ready to Eat ration over 3 days of arduous work.

*First Strike ration elicits similar blood chemistries as Meal, Ready to Eat during 3 days of field consumption.* S. Montain, J. Cuddy, J. Domitrovich, S. Harger, L. Harris, D. Slivka, N. Yasuda, B. Ruby. U.S. Army Research Institute of Environmental Medicine (ARIEM), Natick, MA, and the University of Montana. Conducted under a memorandum of understanding with ARIEM, University of Montana, and MTDC.

## Hydration Systems

Firefighters need to be well hydrated to work hard and think clearly. This study examined the use of water bottles and sipping hydration systems (with hydration reservoirs and a sipping tube) on hydration and work output during fire suppression. Twenty-seven wildland firefighters (18 male, 9 female) in a cross-over design used standard water bottles on one day and a 3-L sipping hydration system on another day. Urine samples were collected before and after the shift to determine hydration status, and subjects recorded total urine voided during the shift. Body weight was taken before and after breakfast and after the shift. Activity monitors (Minimitter, Bend, OR) were worn continually to record work output. During the work shift, subjects only consumed water from their specific hydration system. Water consumed during the work shift was monitored. At the end of the day each subject completed a subjective survey regarding the hydration system.

There were no significant differences before and after the shift between delivery systems in body weight (sipping system, 0.78 kg weight loss; water bottle, 0.80 kg weight loss), urine specific gravity, water consumed (sipping system, 3.41 L; water bottle, 3.09 L) and urine output (sipping system, 1.87 L; water bottle, 1.76 L). There was no difference in hourly work output during the work shift between delivery systems. Subjects thought the water was cooler when they used the sipping hydration system. This may have been because of the water reservoir's location in their pack.

Firefighters have used water bottles as their primary means of carrying water. Sipping hydration systems provide the opportunity to try a different hydration system. Our results demonstrated no differences in hydration status and work output between firefighters who used water bottles and those who used sipping hydration systems during wildfire suppression. Sipping hydration systems are a promising tool for use in wildland fire suppression. (For more information on hydration systems see the Field Notes section of this report, page 10.)

*Hydration delivery systems for wildland firefighters.* J.W. Domitrovich, S. Gaskill, B. Ruby, and B. Sharkey. The University of Montana and MTDC. Funded by MTDC.

## Cardiovascular Risks of Incident Management Team Members

Incident management teams provide the organization and structure for effective wildland firefighting operations in the United States. Additionally, the teams are coordinating and managing the response to a broader category of natural and manmade disasters. The physical requirements of each position in the team depends on the job category, ranging from sedentary jobs to arduous physical work.

This study evaluated the health status and risk for coronary artery disease in a sample of incident management team members. An e-mail survey was sent to team members in Region 1 (Northern Rockies). The survey asked for self-reported data covering risk factors for coronary artery disease, including questions on physical activity and medications. The response rate was 72 percent with 6 responses that were unusable because of limited data. The responses of 66 team members were evaluated, including 52 males and 14 females. The average age was 51.2 years, with an average of 8.5 years spent serving on a team. Overall, the team members mirror national demographics in terms of cardiovascular risk factors relative to their age. They had an average of 2.6 of the following risk factors:

- 41 percent had high cholesterol values or took cholesterol medications
- 39 percent had high blood pressure or used medications for blood pressure
- 39 percent were sedentary during extended periods
- 35 percent were overweight
- 17 percent had a family history of coronary artery disease
- 3 percent were diabetic

Respondents reported above-normal levels of physical activity, but had normal cardiovascular fitness levels for their age, with 22 percent reporting musculoskeletal problems. When evaluated by their position on the team, individuals whose jobs required more physical activity reported fewer risk factors than individuals in more sedentary positions. A number of positions had just a few persons responding, but of the positions with several persons responding, individuals with a higher risk of coronary artery disease included: communications unit leaders, computer technical specialists, facilities unit leaders, incident commanders, logistics section chiefs, public safety communications, and resource unit leaders.

Low-risk positions included: division supervisors, geographic information system specialists, public information officers, and safety officers.

There were limited gender differences. When evaluated by age categories (younger than 48, 48 to 55, older than 55), individuals in the younger group had few risk factors and were more fit aerobically, while the individuals in the two older groups were not significantly different from each other.

Incident command team members whose job positions required little or no physical activity were at increasing risk of coronary artery disease compared to members whose positions required extended walking and fireline activities (table 1).

Table 1—Percent of incident command team members with risk factors for coronary artery disease.

Risk Factor	Camp Jobs (percent)	Active Jobs (percent)
Sedentary lifestyle	54	30
Overweight	46	20

While this survey represents a small sample, there are clear trends. These data suggest the need for risk-reduction interventions, both at fire camp and away from fire camp, especially for individuals whose job descriptions require little or no physical activity. Members of incident management teams represent the collective history along with much of the practical institutional knowledge about wildland firefighting. Agencies need to promote wellness and coronary artery disease risk reduction. Additional work is needed to determine successful interventions for risk reduction.

*Health risks in incident management teams.* S. Gaskill, B. Sharkey, and E. Lieberg, University of Montana and MTDC. Supported by MTDC.

## Maintaining Firefighters' Personal Relationships

Wildland firefighting places a wide variety of demands on fire personnel. The many days away from home and the unpredictability of work schedules can complicate interpersonal relationships. Charles Palmer, a former smokejumper who is an assistant professor in the University of Montana's Department Health and Human Performance, conducted a study to understand the degree to which these factors affect firefighters.

A brief survey was administered to 249 wildland firefighters (216 males, 33 females). The firefighting experience of those surveyed ranged from less than 2 years to more than 30 years. The survey sample included a wide array of firefighters (type I and II fire crews, smokejumpers, helitack and engine personnel, dispatchers, and personnel serving in a variety of overhead positions).

Responses to the survey suggested that firefighters can have a difficult time adjusting to the demanding schedule of the job, and that the demanding schedule can present challenges to firefighters in their relationships with family and friends. Firefighters reported that maintaining intimate relationships with others is difficult, due in large part to their demanding schedule. Those who have managed to maintain intimate relationships in the face of these difficulties listed a variety of coping strategies, including:

- Educating a partner early in the relationship about the work demands
- Establishing relationships with other firefighters who better understand the time demands
- Looking for partners with independence and self-confidence who are better able to handle the time apart
- Making the most of opportunities to build and solidify relationships during time off

Further research is needed to clarify the significance of the impacts that firefighting has on personal relationships, and to better understand the types of support that can be provided to firefighters.

*Wildland firefighting and its impacts upon the personal relationships of firefighters.* C. Palmer, Ed. D., University of Montana.

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## Maximizing Human Performance



*Dr. Brent Ruby, director of the University of Montana Human Performance Laboratory, has been awarded a contract from the Department of Defense (Air Force Special Operations Command) to conduct laboratory and field studies on “Warfighter Sustainability: Maximizing Human Performance in Hostile Environments.”*

*The award was based on the University of Montana’s research with wildland firefighters and the applicability of that research to the health and sustainability of warfighters during extended combat and special operations missions.*

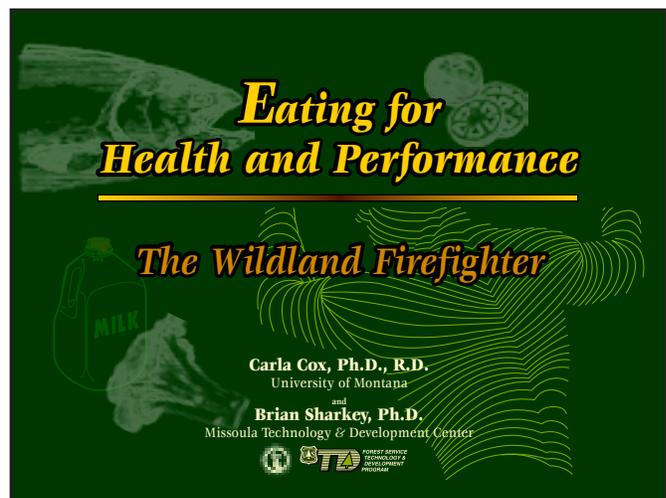
*The studies’ goal will be to enhance the performance capabilities of all special operations personnel in all operational environments. The award will allow expansion of the University of Montana’s Human Performance Laboratory, improvement of the laboratory’s environmental chamber, and acquisition of a mobile laboratory. These changes will enhance the lab’s ability to conduct laboratory and field studies of wildland firefighters.*

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## Eating for Health and Performance

Based on years of study of the energy expenditure and nutritional needs of wildland firefighters, MTDC has developed a nutrition education program, *Eating for Health and Performance: The Wildland Firefighter*.



Title slide from the presentation, *Eating for Health and Performance: The Wildland Firefighter*.

Recent research has identified nutritional strategies that will improve the health, safety, and performance of wildland firefighters. The right food sources eaten at the proper times provide energy and nutrients that help sustain work output and maintain the immune system. Supplemental high-energy foods delay fatigue and further enhance immune function while maintaining the ability to think and make decisions during hard work.

The program was developed by Carla Cox, Ph.D., a registered dietician associated with the University of Montana Human Performance Laboratory, and Brian Sharkey, Ph.D., a project leader at MTDC. Cox’s research interests include nutrition for endurance athletes and

wildland firefighters. Sharkey has studied wildland firefighters for over 40 years. He is a professor emeritus at the University of Montana and past president of the American College of Sports Medicine.

Firefighters are endurance athletes who require twice as many calories as normal—or more—when they are working on the fireline. To maintain their health and ensure peak performance, firefighters need to eat like athletes. The nutrition education program was designed for wildland firefighters, incident management and support personnel, and those interested in good nutrition for health and performance. The program identifies energy and nutrient needs, the timing of food intake, information on vitamin and mineral supplements, hydration, and weight management. It emphasizes the value of intermittent feeding (using shift food) to maintain blood glucose, work output, immune function, mood, and decisionmaking throughout the workshift.

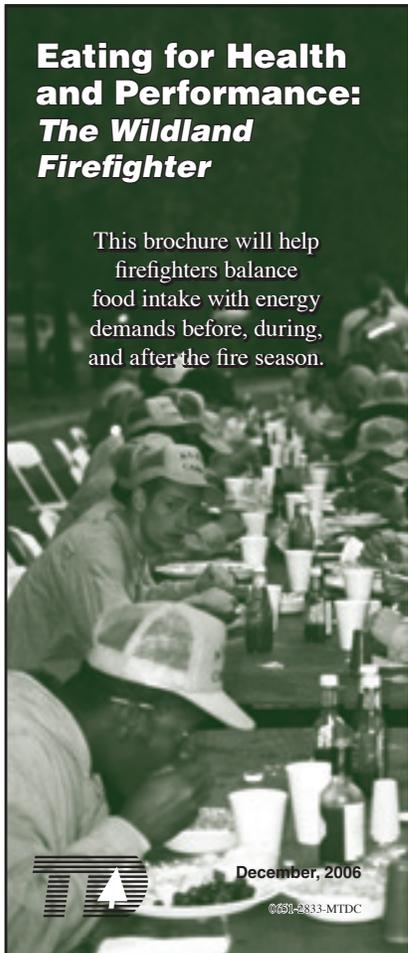
## The Nutrition Education Program

The *Eating for Health and Performance: The Wildland Firefighter* program includes a PowerPoint presentation, an instructor’s guide, and an informational brochure.

The PowerPoint presentation has three parts:

- Energy for work: calories
- Nutrients and hydration
- Related issues, including immune function, ergogenic aids, special needs of incident management teams, and weight management

The brochure has more detailed information on carbohydrate and protein requirements that will allow firefighters to calculate their individual needs. The brochure also includes the addresses of Web sites that provide additional information. The instructor’s guide includes a view of each slide and important points that clarify or amplify the slide’s content.



**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.

December, 2006  
©631-2333-MTDC

**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 energy balance. The morning before breakfast (calories) comes from carbohydrate.

**Carbohydrate**  
Carbohydrate is converted and muscle as glycogen molecules. Muscle glycogen work; liver glycogen is the primary fuel for the brain. Blood glucose levels drop during activity, carbohydrates are used to produce blood glucose. If there is not enough carbohydrate to use from muscle protein, muscle protein is needed.

**Carbohydrate Requirements**  
High levels of continuous firefighting for hours, each firefighter has specific requirements. Each firefighter needs a certain number of calories of energy.

The following example shows carbohydrate requirements based on body weight (in pounds) 154 (weight in kilograms) 70.

**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.

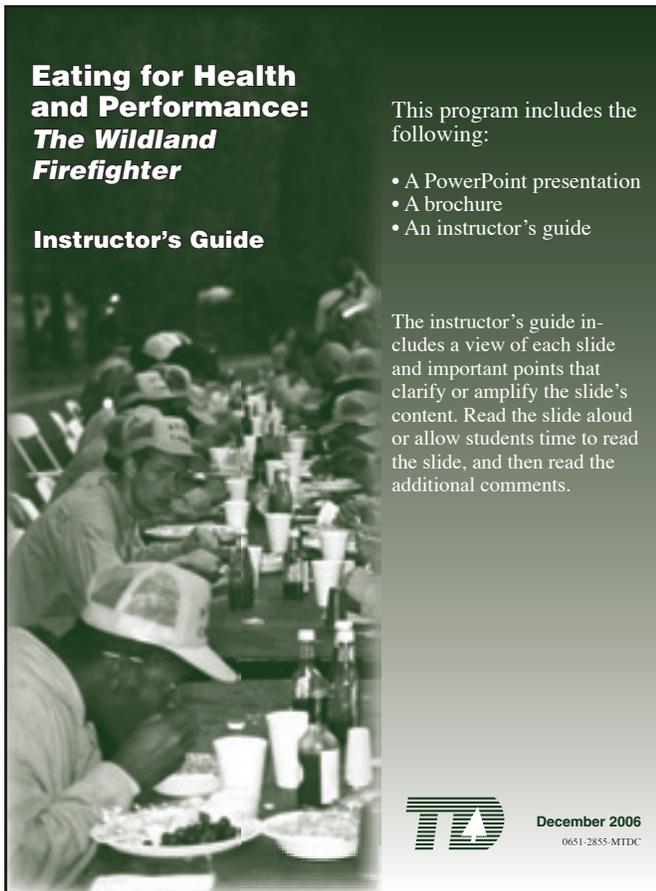
**A firefighter should consume:**

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

\*Whole grains and enriched or whole-grain products.  
\*\*Meat, fish, or meat substitute.

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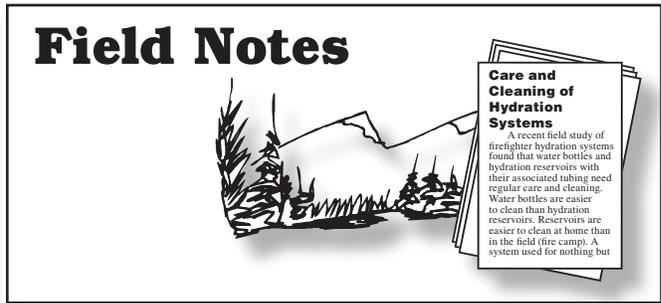
Firefighters can take this brochure home after the training or download it from MTDC’s Web site.



Cover of the instructor's guide for the nutrition education program for wildland firefighters.

## Getting the Nutrition Education Program

The *Eating for Health and Performance: The Wildland Firefighter* CD with the PowerPoint presentation, the brochure, and the instructor's guide can be ordered from MTDC or the different parts can be downloaded from MTDC's Web site: <http://www.fs.fed.us/eng/t-d.php>.



## Care and Cleaning of Hydration Systems

A recent field study of firefighter hydration systems found that water bottles and hydration reservoirs with their associated tubing need regular care and cleaning. Water bottles are easier to clean than hydration reservoirs. Reservoirs are easier to clean at home than in fire camp. A system used for nothing but water is easier to clean than one that sometimes carries sport drinks. This section suggests several ways to clean water bottles and hydration reservoirs.



An insulated hydration reservoir.

## Cleaning

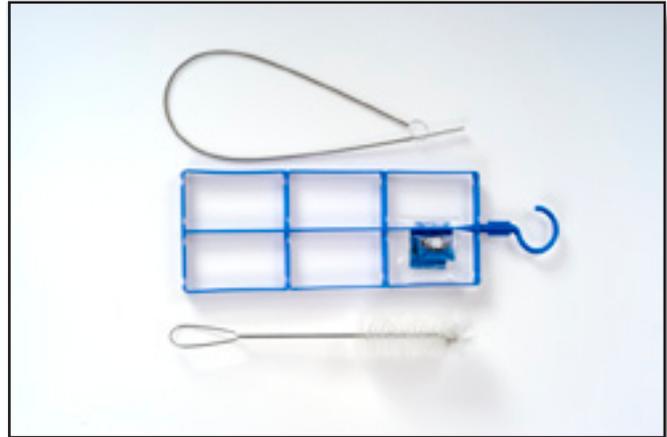
Water bottles and hydration reservoirs should be rinsed with warm water after each use. Regular use of a biodegradable dishwashing detergent deters microbial growth. Wash and rinse thoroughly with warm water, then allow the system to dry. Cleaning tablets that generate chlorine dioxide are designed for hydration systems. They clean the system without leaving an unpleasant taste. Allow the chlorine dioxide tablet to soak in the system for 5 minutes, then rinse and dry. A mild bleach solution is cheaper than tablets, but it can leave a taste and it could shorten the life of the system.



## Cleaning Kit

Kits are available for cleaning the hydration reservoir and its associated tubing. The kits include brushes for the reservoir and tubing and a frame to hold the reservoir open so it can dry. Some kits include cleaning tablets. The brushes are used to clean hard-to-reach areas of the reservoir and tubing. Some reservoirs can be turned inside out to dry. Complete drying is the only way to avoid microbial growth.

Water bottle or sipping hydration systems should be cleaned regularly. Those used to carry carbohydrate sport drinks will require more care to avoid microbial growth. Use detergent or cleaning tablets on a regular schedule or whenever the water bottle, reservoir, or tubing is dirty or shows signs of microbial growth.



Cleaning kit for a sipping hydration system.

## Recommendations

Water bottles are easier to clean than a hydration reservoir and its tubing. We recommend that firefighters use a water bottle to mix and carry sport drinks, carrying additional water in a water bottle or hydration reservoir. We discourage the use of hydration reservoirs for anything other than water. Putting carbohydrate sport drinks or other fluids with sugar into the hydration reservoirs greatly increases the potential for microbial growth and cleaning problems. Crews that use hydration reservoirs should order and use cleaning kits and cleaning tablets.



## Library Card

**Sharkey, Brian.** 2007. Wildland Firefighter Health & Safety Report: No. 11. 0751–2803P–MTDC. Missoula, MT: U.S. Department of Agriculture Forest Service, Missoula Technology and Development Center. 12 p.

The featured topic discusses intermittent feeding (shift food) for firefighters. The Research section of this issue summarizes findings from studies of firefighters conducted during the 2006 fire season. The Risk Management section introduces a nutrition education program, *Eating for Health and Performance: The Wildland Firefighter*, designed for wildland firefighters and incident management team members. The program includes a PowerPoint presentation, a brochure, and an instructor's guide. The Field Notes section, based on a summer field study, offers advice on how to clean a water bottle or a sipping hydration system with a reservoir and tubing.

**Keywords:** caffeine, eat on the move, fire fighting, First Strike rations, Human Performance Laboratory, meals, nutrition, rations, research, snacks, shift food, University of Montana, water bottles

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## About the Author

Brian Sharkey, an exercise physiologist at MTDC, has done research and development work on fitness tests and programs, heat stress, hydration, nutrition, protective clothing, tools, fatigue, work/rest cycles, and employee health (wellness). His work has been honored with USDA Superior Service and Distinguished Service Awards, and a Forest Service Technology Transfer Award. He is a researcher, author of several books, and past president of the American College of Sports Medicine.

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<http://fsweb.mtdc.wo.fs.fed.us/search/>

### For additional information about wildland firefighter health and safety, contact Brian Sharkey at MTDC:

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



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