



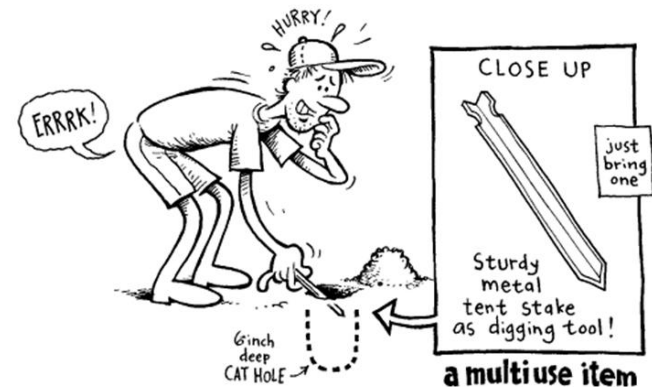
An Engineering Evaluation of Camping Stove Technology By A Lightweight Backpacker

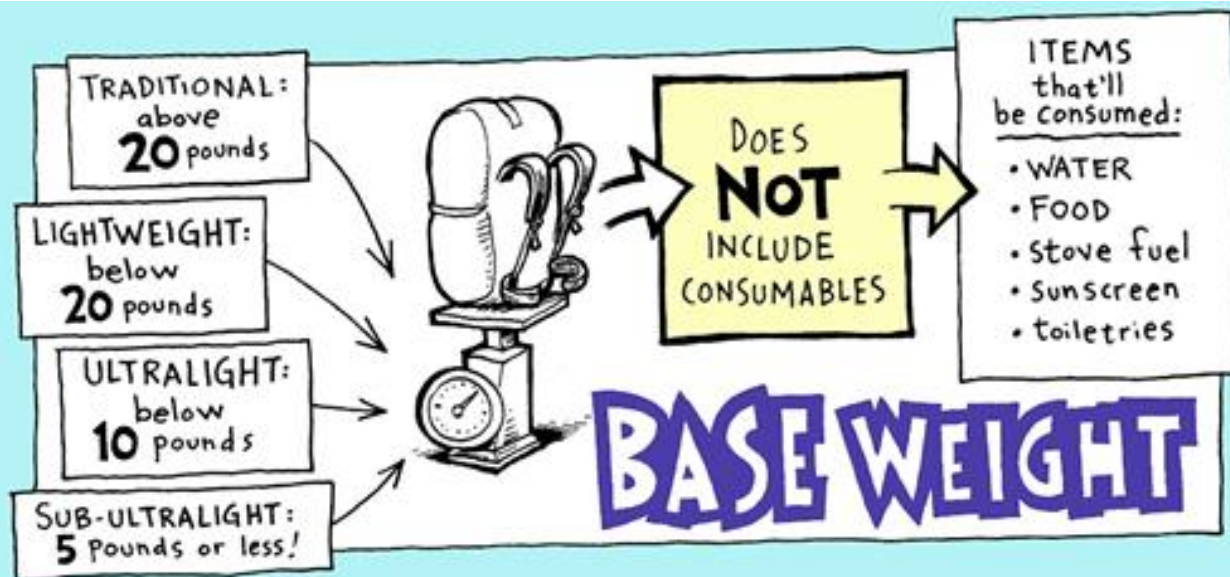
(with BSA and CCP Policy Update)

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Principles of Lightweight Backpacking

1. Take enough gear to be safe, comfortable and confident.
2. Know the actual weight of each item.
3. Whenever possible, use multipurpose items.
4. Look at the heaviest items first.
5. When selecting items, use the smallest items that will suit your needs.
6. Choose lightweight gear that is useful, sturdy and dependable.





Packing Categories

No.	Description	Notes
1	Risk Management	Know before you go: weather forecast , terrain, route and water sources.
2	Pack Weight	My objective is 10-12 lbs
3	Footwear	Trail shoes or low cut hiking boots
4	Backpacks	Gossamer Gear Mariposa
5	Navigation	Map, compass, GPS
7	Clothing System	Weather protection, thermoregulation and layers
8	Sleep System	Sleeping bag or quilt, pad, sleep wear
9	Shelter	Tarp tent
10	Hydration	Platypus , purification tablets
11	Food & Cooking Equipment	Plan for about 2 lbs of food per day, stove, fuel, pot/bowl/cup, spoon
12	Hygiene	Toothbrush, toothpaste (mini size)
13	First Aid	Advil, bandaids, moleskin, tweezer

BSA Policy as updated April 12, 2010

policy on use of chemical fuels ::

National Council, Boy Scouts of America



Policy on the Storage, Handling, and Use of Chemical Fuels and Equipment

Purpose

This policy directs Boy Scouts of America members how to safely store, handle, and use chemical fuels and equipment. Safety and environmental awareness concerns have persuaded many campers to move away from traditional outdoor campfires in favor of chemical-fueled equipment for cooking, heating, and lighting. Be aware that chemical fuels and equipment create very different hazards than traditional wood, charcoal, and other solid fuels; this policy defines how to address those hazards.

Before any chemical fuels or chemical-fueled equipment is used, an adult knowledgeable about chemical fuels and equipment, including regulatory requirements should resolve any hazards not specifically addressed within this policy.

Definitions

Chemical Fuels—Liquid, gaseous, or gelled fuels.

Approved Chemical-Fueled Equipment—Commercially manufactured equipment, including stoves, grills, burners, heaters, and lanterns that are designed to be used with chemical fuels.

Prohibited Chemical-Fueled Equipment—Equipment that is handcrafted, homemade, modified, or installed beyond the manufacturer's stated design limitations or use. Examples include alcohol-burning "can" stoves, smudge pots, improperly installed heaters, and propane burners with their regulators removed.

Recommended Chemical Fuels—White gas (Coleman fuel); kerosene; liquefied petroleum gas fuels, includ-

ing propane, butane, and isobutane; vegetable oil fuels; biodiesel fuel; and commercially prepared gelled-alcohol fuel in original containers.

Chemical Fuels not Recommended—Unleaded gasoline; liquid alcohol fuels, including isopropyl alcohol, denatured ethyl alcohol, and ethanol; and other flammable chemicals that are not in accordance with the manufacturer's instructions for chemical-fueled equipment.

Storing, Handling, and Using Chemical Fuels and Equipment

An adult knowledgeable about chemical fuels and equipment should always supervise youth involved in the storage, handling, and use of chemical fuels and equipment.

Operate and maintain chemical-fueled equipment according to the manufacturer's instructions and in facilities or areas only where and when permitted.

Using liquid fuels for starting any type of fire—including lighting damp wood, charcoal, and ceremonial campfires or displays—is prohibited.

No flames in tents. This includes burning any solid, liquid, gel, or gas fuel; including tents or teepees that feature or support stoves or fires; and any chemical-fueled equipment or catalytic heaters.

Store chemical fuels in their original containers or in containers designed for immediate use. Securely store any spare fuel away from sources of ignition, buildings, and tents.

During transport and storage, properly secure chemical fuel containers in an upright, vertical position.

- Chemical fuels are defined as liquid, gaseous or gelled. Solid fuel tablets are considered a chemical fuel.
- Only allows use of commercial stoves – no homemade stoves (beer can, etc)
- White gas & canister stoves are recommended
- Alcohol is specifically not recommendedbut not prohibited
- Use of any form of chemical fuel – or even wood fire - is dangerous. Troop should require every Scout and Adult have proper training in care and usage of different stove classes similar to Totin' Chip card for knives and axes.
- Remember : **All** stove users must obtain and carry a (free) California Campfire Permit for operating a camp fire or stove on Federal lands in California. Prohibits open flame (uncontrolled) stoves during High Fire Danger periods.



CALIFORNIA CAMPFIRE PERMIT

Name _____

Address _____

City _____ State _____ Zip _____

is authorized to build a campfire, subject to the terms listed on this permit on National Forest Land and Bureau of Land Management Land.

SPECIAL LIMITATIONS: Some areas have special limitations regarding campfire use. It is your responsibility to find out what these limitations are. The best way to do this is by contacting a local agency office in the area you intend to visit. Throughout the year, as fire danger increases, fire restrictions are put into effect. Strict compliance with fire restrictions is required.

TERMS OF PERMIT

Permittee agrees to the following:

1. Clear all flammable material away from the fire for a minimum of five feet in all directions to prevent escape of the fire.
2. Have a shovel available at the campfire site for preparing and extinguishing campfires.
3. Have a responsible person in attendance at all times.
4. Extinguish campfire with water, using the drown, stir, and feel method.



READ AND SIGN

Permittee's signature _____ Date _____
Brent Skaggs, Fire Management Officer, FS/SQF
 Issued by _____ Agency/Unit _____
 December 31, 2012

Expiration Date _____

On National Forest Land:

a) With a Campfire Permit, you may use a:



Wood Fire



Charcoal Fire



Portable Gas Stove

b) In addition, when **FIRE RESTRICTIONS** are in effect, you may use **ONLY** a portable stove with gas, jellied petroleum or pressurized liquid fuel outside of developed recreation sites, or designated fire use areas.



ADDITIONAL INFORMATION

- On private land you must have written permission from the landowner for campfire use.
- Some designated wilderness areas require a special permit.
- Many high-country areas prohibit wood fires to protect scarce vegetation.
- If you smoke outside a vehicle, be sure you do so within a cleared area at least 3 feet in diameter.

Definition: A **campfire** is a fire which is used for cooking, personal warmth, lighting, ceremonial or esthetic purposes that is not within a building, mobile home or living accommodation mounted on a motor vehicle. Campfires include wood fires, charcoal fires, and portable gas stoves using gas, jellied petroleum or pressurized liquid fuel.

Liability: You are liable for the cost of suppression and damages caused by any wildfire that starts through your negligence. Reference California Health and Safety Code 13009, Suppression costs collectable.

Federal Law prohibits discrimination in employment or delivery of program services on the basis of race, color, sex, age, religion, national origin, marital status or disabling condition.

Trail Food and Cooking On The Trail

- Your meal plans, choice of stove, fuel requirements, cooking and eating equipment are all interrelated issues. That's why I don't think of individual gear - only the overall solution to the Food and Nutrition **Category**.
- Simple meals = Simple and light equipment, simple meal preparation, little or no cleanup, more enjoyment
- Do I need hot water for cooking? How much?
- Do I need to boil water for water treatment?

Fuel Options

Type	Examples	Pros and Cons
Solid	Esbit or Trioxane fuel tablets	Very small stoves. Each tablet can burn for about 15 minutes and boil up to 2-3 cups of water. Only have to bring what you need.
Liquid #1	Denatured Alcohol	Only bring the fuel you need. Can boil 1-2 cups of water at a time. Not ideal for windy conditions, very cold temperatures or high altitude (> 15,000 ft). Can spill or leak.
Liquid #2	White Gas (aka Coleman Fuel)	Only bring the fuel you need. Good at all temperatures. Priming and pumping requires some skill. Require maintenance. Can spill or leak.
Canister	Isobutane Mix	Easiest to use. No maintenance. High heat output. Operating problems at very cold temperatures. How to manage used canisters?
Biofuel	Small branches, twigs, leaves, pine needles	Fuel is free and everywhere. Beware that stove and pot get covered with soot.

What Size Pot Do I Really Need?

- 1 cup=8oz=235ml, 2 cups=16oz=470ml
- Cups/Mugs
 - \$13 for GSI 530ml Glacier Stainless Mug (4.4 oz)
 - \$36 for SnowPeak 450ml Titanium Mug (1.9 oz)
- Kettles (with lids)
 - \$40 for SnowPeak Trek 700ml Ti Mug (4.8 oz)
 - \$55 for Vargo 700ml Ti-Lite Mug (4.9 oz)
 - \$60 for MSR 830ml Titan Tea Kettle (4 oz)
- Pot
 - \$16 for Open Country 2 Qt Aluminum Pot (5 oz)
 - \$55 for Evernew 1.3L Titanium Pot (4.6oz)
- Sets
 - GSI Outdoors Soloist or Dualist Sets (\$45-\$65)
 - SnowPeak Mini Solo Set (\$65)





Esbit Fuel Tablets

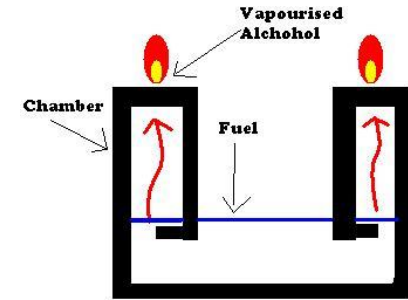


- Fuel Availability: Most sporting goods stores
- Fuel Cost: \$7 for 12 0.5-oz tablets
- Most efficient for boiling 1-2 cups of water, 5-6 minutes
- One 14g tablet will burn for about 12 minutes
- Fuel required to boil 2 cups: < 1 tablet
- Can use unburned leftover tablet or cut to size
- Stove Cost
 - \$12 for Esbit Pocket Stove (includes 6 tablets)
 - \$15 for Esbit Titanium “Wing” Stove
 - \$30 for Esbit 535ml Cookset (Wt=7 oz)
- Cook With Cup or Mug or Small Kettle





Alcohol



- Fuel Availability: Denatured alcohol (ethanol) can be found in hardware and paint stores. Yellow HEET (methanol) can be purchased at auto supply stores. Do not use isopropyl alcohol or Iso-HEET!
- Fuel Cost: \$8 for 1 qt (32oz)
- Time to boil 1-2 cups: 5-6 minutes
- Fuel required to boil 2 cups: 1.5 oz
- Most efficient method for boiling 1-2 cups or 3-4 cups of water at time depending on size of stove and pot. Beware of fuel spillage or container leaks.



- Stove Cost

- \$15 for Gran Weenie PRO Stove (Capacity=1 oz)
- \$23 for White Box Solo II Stove (Capacity=1.5 oz)
- \$23 for Original White Box Stove (Capacity=3 oz)
- \$20 for Trangia or Esbit Alcohol Stove (Capacity=3 oz)





White Gas aka Coleman Fuel



- Fuel Availability: All sporting goods stores
- Fuel Cost: \$13 for 1 qt (32oz), 110 mins/20oz
- Time to boil 2 cups: 4-5 minutes
- Fuel required to boil 2 cups: 0.5 oz
- Requires some skill to efficiently pump, prime and light. Universal models can burn various liquid fuels as well as canisters. Requires maintenance. Beware of spills & leaks.
- Stove Cost
 - \$80 for MSR Whisperlite Shaker Jet
 - \$139 for MSR Dragonfly
 - \$140 for MSR Whisperlite Universal
 - \$154 for Primus Omnifuel (Universal)





Isobutane Canisters



- Fuel Availability: All sporting goods stores
- Fuel Cost:
 - \$6 for 100/110g “mini” canister (26 min, Wt=6.6 oz))
 - \$10 for 230g “regular” canister (55 min, Wt=
- Fuel required to boil 2 cups: 5g
- Fast lighting and quick boil (3min). Canister top mount or tripod styles. Optional built-in piezo lighter.
- How to manage partially used canisters?
- Stove Cost (\$30-\$150)
 - \$40 for MSR PocketRocket
 - \$50 for SnowPeak Gigapower w/Piezo Lighter
 - \$100 for Jetboil Flash, \$150 for Solo Ti, \$130 for Sumo
 - \$140 for MSR Whisperlite Universal





Biofuel



- Fuel Availability: On the ground
- Fuel Cost: \$0
- Boil 2 cups of water in 10-12 minutes
- Utilizes efficient dual chamber stove design for most efficient fuel burn and heat generation. Pot and stove will get dirty. Some models like Sierra Stove have battery-operated fan while Biolite is self-generating.
- Stove Cost
 - \$70 for ZZ Sierra Stove with fan
 - \$90 for Solo Stove
 - \$120 for Bushbuddy Standard or Ultra
 - \$129 for Biolite CampStove (33 oz)



Gear Geek Extra Biolite CampStove



- Price: \$129.00
- Wow! Burns twigs and generates electricity! That's cool!
- Weight (without pot) = 33 oz. Not lightweight.
- Generates own electricity for internal fan. Good!
- Fire Power Output: 3.4kW (LO), 5.5 kW (HI)
- USB (5V) Power Output: Max continuous=2W, Peak=4W
- 2 hrs of HI continuous burn will only charge a typical smartphone 50%. Not so great! Why bring a phone anyway?
- Scalable for 3rd World Home Use: Biolite HomeStove



Introducing The BioLite HomeStove™

50% Less Wood Consumed

Time and Cash Savings

95% Smoke Reduction

Improved Health

Nearly Eliminates Black Carbon

Protects Climate

Generates Electricity

Charges Phones & LED Lights



Comparisons for 2 Hot Meals

Type	Equipment & Fuel	Total Weight	Total Cost
Esbit	Esbit folding stove GSI Glacier Mug 4x Esbit tablets (0.5 oz each)	9 oz	\$26
		(6oz with SnowPeak 450ml Mug)	(\$44)
Alcohol	GramWeenie PRO or WhiteBox Solo GSI Glacier Mug 3oz Denatured Alcohol & Bottle Wind Screen	8 oz	\$32
White Gas	MSR Whisperlite Shaker Jet MSR 11oz fuel container 1 oz White Gas fuel (bring 2 oz) MSR Titanium Kettle	20 oz	\$155
Canister #1	MSR Pocket Rocket 100g Isobutane canister MSR Titanium Kettle	14 oz	\$181
Canister #2	JetBoil Solo Ti 100g Isobutane canister	18 oz	\$155
Biofuel	Bushbuddy Ultra MSR Titanium Kettle	10 oz	\$180

Comparisons for 10 Hot Meals

Type	Equipment & Fuel	Total Weight	Total Cost
Esbit	Esbit folding stove GSI Glacier Mug 10x Esbit tablets	15 oz	\$30
		(9 oz with SnowPeak 450ml Mug)	(\$46)
Alcohol	White Box Solo II Windscreen SnowPeak 450ml mug 15 oz Denatured Alcohol 16.9 oz Empty Water Bottle	19 oz	\$65
White Gas	MSR Whisperlite Shaker Jet MSR 20oz fuel container 5 oz White Gas fuel (bring 6 oz) MSR Titanium Kettle	24 oz	\$165
Canister #1	MSR Pocket Rocket 100g Isobutane canister MSR Titanium Kettle	14 oz	\$181
Canister #2	JetBoil Solo Ti 100g Isobutane canister	18 oz	\$155
Biofuel	Bushbuddy Ultra Vargo 900ml Ti-Lite Mug	10 oz (285 g)	\$180

Stove and Trail Meal Wrap-Up



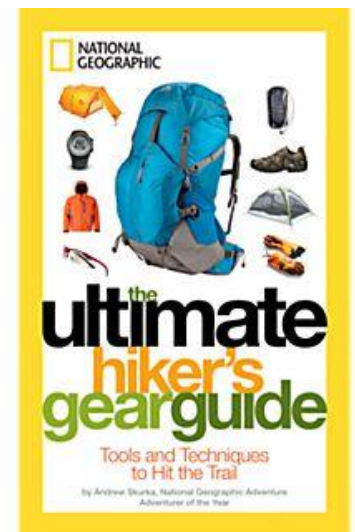
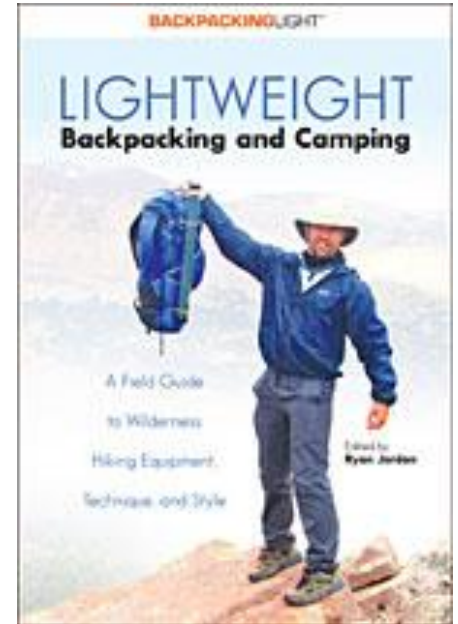
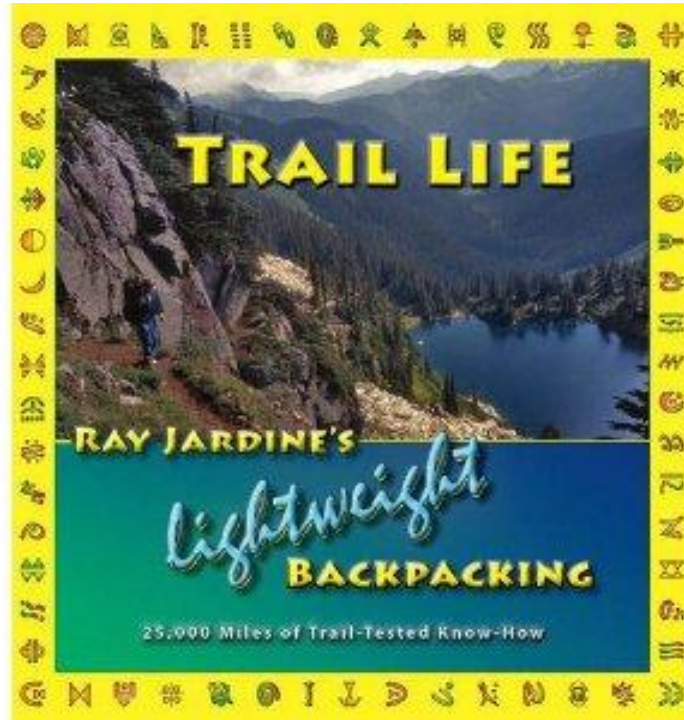
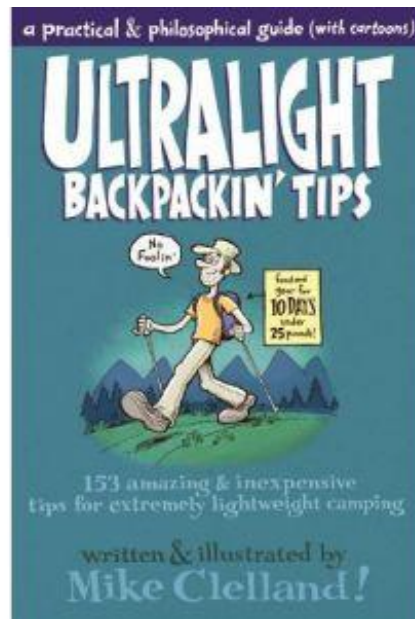
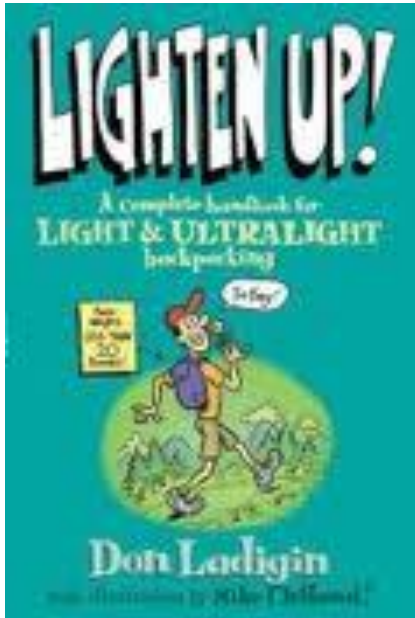
1. For a 1-3 nites out, cooking with Esbit tablets or alcohol offer smallest, lightest & least expensive cooking option.
2. For 3-10 nites out, canister, white gas and biofuel stoves are the most efficient options.
3. We have assumed simple solo backpacking meals requiring 2 cups of boiled water.
4. Soup as a first course is a convenient way to rehydrate once in camp as well as restore salt levels.
5. Do-It-Yourself Freezer Bag meals can offer tastier and less expensive alternative to commercial BP meals.
6. Always hang your food at least 100 feet from where you sleep and cook. These 3 areas should form a triangle.

Lightweight Backpacking Recap

1. Go lighter...Enjoy more
2. Lightweight backpacking is not just about the equipment. It's also about having the skills (wilderness first aid too!) and confidence to deal with uncertainty.
3. Don't be reckless in being light. Managing risk is about acting responsibly. Don't push 911 on your the Spot Personal Messenger unless the situation is truly life threatening.
4. Weight your back before and after a trip. What did I forget to bring that I wish I had? What did I bring that I will never use? Too much food? Too much fuel?



LWBP Resources



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TECHNIQUES