

- I. STOVES: The following information relates to stove use in the out of doors. Some of this is covered in you text. Stove safety and operation will be covered in lad and during trips.
- A. Environmental Considerations – One of the seven, primary principles of Leave No Ethics is to minimize campfire impacts. Leave No Trace recommends that stoves be used instead of fires. Even if you are in an area where fires are permitted, use a stove when:
 1. Firewood is scarce (i.e., dead and down firewood cannot be readily found).
 2. If wood available is not small enough to break with your hands.
 3. The area is heavily camped.
 4. There is concern that the firewood supply will not readily replenish itself.
 5. There is any doubt about what the environmental impact might be.
 6. If the materials are not available to build a minimum impact fire. (i.e., fire pan or materials for mound method)
 7. Land management agencies indicate high fire danger, fire bans or if students are not capable of safely managing fires.
- B. Choosing the best stove and fuel for a particular trip.
 1. Butane stoves: These stoves operate off of pressurized canisters. These stoves require no priming, flame can be regulated with ease, performance goes down in cold weather, and is found internationally.
 2. Propane stoves: These stoves use heavier cartridges to accommodate higher pressures. This stove performs similar to butane but with better performance. Propane fuel is limited internationally. Pressurized canister stoves tend to cost more to operate per hour compared to the liquid stoves. Refillable propane tanks and double burner stoves are commonly used in water-based programs such as rafting.
 3. Denatured alcohol stoves: These stoves burn clean, quietly and are not highly flammable compared to other gas stoves. This stove generates less heat, which increases cooking time.
 4. Kerosene stoves: These stoves tend to be tricky to prime and the flame burns dirty leaving black residue on pots. Once kerosene is hot enough to burn efficiently the stove puts out a hot flame equal to a white gas stove.
 5. White gas stoves: These stoves are efficient, hot, clean burners. The liquid is highly flammable and not readily available internationally. This tends to be one of the most commonly used stoves in U.S. outdoor programs.
 6. Multi-fuel stoves: These are liquid gas stoves that have the ability to burn a variety of fuels such as white gas, kerosene, unleaded gas or leaded gas. These stoves are ideal for international travel when fuel sources are unknown. Some stove types require more care and cleaning when using non-white gas fuels.
- C. General stove safety for white gas stoves with priming pumps:
 1. Reinforce the idea that using the stove is probably the second most dangerous thing done on the course. (The most dangerous aspect of an expedition is traveling in vehicles.) As long as some basic safety considerations are followed, problems are minimized.
 2. Considerations for stove location:
 - a. Level area.
 - b. Stable area.
 - c. Non-flammable surroundings (use a fire retardant cloth like nomax to place on to prevent ground fires).
 - d. Protection from the wind (wind screens also help decrease cooking times)
 - e. Not in a tent unless there are no other options.
 - (1) If you must cook in a tent, do not start the stove in the tent.
 - (2) Be sure there is adequate ventilation, since CO₂ fumes can be toxic in the close quarters of a tent.

- (3) Check with the agency sponsoring the group, since policies vary regarding stoves in tents.
 - (4) Cooking in tents should be considered a last resort, wintertime activity.
 - 3. If the stove should flare up and/or burst into flames:
 - a. If possible, turn the stove off.
 - b. Smother the stove by putting a large pot or another appropriate object over the stove. The object must fit completely over the entire stove cutting off all oxygen to extinguish the fire. The results are immediate. Nomax cloth can also be used to smother the flame.
 - c. Do not use water to extinguish the flame. This will only help spread the fire. Fuel is lighter than water and will stay on top of it.
 - d. As a last resort, throw sand or dirt on the stove to extinguish the flame. While this method works, the stove will have to be cleaned thoroughly.
 - e. Under extremely dry conditions, consider wetting the ground around the stove to prevent the duff from igniting.
 - 4. General stove maintenance
 - b. Be sure to check for loose nuts and bolts especially around fuel valves. This should be done before entering the field. Carry pliers (i.e., multitool for stove repair and maintenance while in the field).
 - c. Make sure gaskets on fuel caps are secure and not compromised in any way. (i.e. cracked)
 - d. Use a filter when pouring fuel into the stove's fuel tank to prevent debris from entering the stove.
 - e. Also pack extra parts that tend to go bad or get lost in the field, i.e. pump leathers, generators, o-rings, gaskets and extra fuel caps.
 - f. Make sure fuel pump remains lubricated. (can use vegetable oil in a pinch to lubricate a fuel pump)
- D. Safety considerations for fueling liquid gas stoves:
1. Filling the stove - Judgment dictates the following considerations:
 - a. No open flame should be nearby (i.e., other lit stoves, candles, cigarettes, etc.).
 - b. Establish a fuel station for the group approximately 50 feet from the kitchen area: Fill the stove in a different location than where it will be lit and used. Any fuel that may have been spilled when the stove was filled could ignite when the stove is operating.
 - c. Gas vapors are heavier than air and float along the surface of the ground and will ignite if they come into contact with open flame. This is another reason to establish a fuel station away from the cooking area.
 - d. When taking off the stove's fuel cap, keep away from your face to prevent pressurized gas from spraying into the eyes. (If gas enters the eyes, flush immediately and rigorously for several minutes.)
 - e. The stove should be cool before filling.
 2. The fuel bottle
 - a. Be careful not to lose any washers to the fuel bottle cap to prevent fuel leakage.
 - b. Be careful not to cross-thread the fuel bottle cap threads.
 - c. Be careful not to lay fuel cap on ground where it will pick up debris that may eventually work its way into a stove to clog fuel lines.
 - d. When opening a fuel bottle, hold far away from the face to prevent pressurized fuel from spraying into the eyes.
 3. The stove
 - a. Be careful not to lose the stove fuel tank cap. Place it where you can easily find it and where it will not pick up dirt and debris.
 - b. Follow the manufacturer's directions to determine how much to fill the stove. Most stoves should be filled three--quarters full. Overfilling a stove does not allow enough space for the fuel to vaporize, creating a hazard in which pure fuel could ignite rather than fuel vapors. One way to trouble shoot - The user

- typically experiences a consistent, large yellow flame that may grow if the valve is left open.
- c. Once the stove has been filled, securely replace the stove fuel tank cap and the fuel bottle cap.
 - d. It is expedient to fill the stove before each use.
 - (1) The fuel won't run out in the middle of cooking a meal.
 - (2) The stove can be filled without having to wait for it to cool.
- E. Stove Terminology - Explain all the parts of the stove and their functions.
- F. Stove Operation
1. Basic principles of gas stove operation
 - a. Stoves must be primed. This is the process of warming up the stove so that pressure builds in the fuel tank. When pressurized, liquid fuel becomes vapor. Vapor burns hotter and cleaner (this ensures a hot, blue flame as opposed to a yellow flame). Some stoves require that fuel be poured directly on stove and lit to prime it. Others are equipped with pumps to pressurize the stove. (Be sure to read the operating instructions.)
 - b. Remember that propane stoves must be treated differently. The fuel already comes pressurized in the fuel tank and does not require priming.
 2. Stove starting
 - a. Have a pot of water or food ready to go before lighting it. Valuable fuel is wasted if a stove runs without the pot or pan on top.
 - b. Explain and demonstrate how to start the stove using the manufacturer's operating instructions.
 - (1) Light the match before turning on the gas. This is done to ignite the vapors as soon as the valve is turned on to prevent vapor build up and a mushroom cloud explosion effect when lighting.
 - (2) Teach the participants to light the stove in the "Light To Go Position"! (In a squatting position on your feet with head back away from the stove – do not sit or kneel to light a stove) This position keeps the user on their feet so they can quickly spring out of the way if the stove produces a large, unexpected burst of flames. Keeping the face and head back prevents losing body hair. Long hair, loose clothing, etc. should be pulled back.
 - (3) Hold the match upside down so it will burn better.
 - (4) Once match is completely out, do not lay on the ground. Have trash bag handy to deposit the match. Matches have a way of disappearing in leaves and dirt and tend to be forgotten as litter.
 - c. Explain the principles of how the specific stove being used for the course operates.
 - d. If using a stove on snow, some insulation (e.g., a small ensolite pad) can be placed below it to prevent it from sinking into the snow.
 3. Once the stove has warmed up.
 - a. Use gloves.
 - (1) Minimize the chance of getting burned.
 - (2) They can be used as potholders.
 - (3) They are helpful when turning the stove off.
- G. Packing the Stove
1. Let the stove cool before packing it.
 2. Be sure it is protected so it won't get damaged or damage other items in the pack.
 3. Release fuel pressure by loosening the cap but be sure to retighten it securely, making sure the on/off valve is in the "off" position.
 4. Pack the stove upright to minimize the chance of fuel leakage.
 5. Pack the stove well away from food items to prevent potential contamination.

