ALL ABOUT FALLOUT

Guiding Principle:
the more mass between you and the fallout - the better

Fallout is simply radioactive dust from a nuclear explosion. Fallout acts like ordinary dirt and dust when it falls to earth. Fallout dust just happens to be radioactive too.

If you could surround yourself with a mass equivalent to 150-175 pounds per square foot of *anything* in all directions, you would have a shelter which would cut your exposure to gamma radiation by 99%. You would only get 1% (pf=0.01) of the dose of an unprotected person outside your shelter.

You could use 150-175 pounds of books or newspaper per square foot of shelter wall space. The same 150-175 pounds of mass could be canned goods, or packed dirt, or concrete blocks. A few inches of heavy lead would also do the trick. So anything can be used as shielding, but heavier stuff is preferred as being more compact.

All of these will also reduce radiation exposure by 99% (pf=0.01):

steel - 6.6 inches
concrete - 22 inches
earth - 32 inches
water - 48 inches
wood - 76 inches

Radiation

Fallout particles act as sources of gamma or x-ray radiation, which is our key concern here. Fallout particles also give off less penetrating radiation known as alpha and beta particles. These particles are also dangerous if inhaled, ingested, or if left on your skin. However, alpha radiation is blocked by most clothing, and beta particles are blocked by an inch or two of wood or other shielding. So we will worry most about the gamma rays emitted by fallout, which are the most penetrating and dangerous to us even within most shelters.

Measurement

The amount of gamma or other radiation can be measured in physical units called rads or in a biological equivalent dosage called REMs. Ideally, calibrated instruments would be available to measure the radiation dosage rate and accumulated dose. But if you don't have such instruments handy, don't panic. Our tips here will help you to select the best available local shelter based on some simple principles. Knowing your exact dosage is less important than knowing how to minimize that dosage, thanks to the ideas discussed below!

Gamma Rays

Each fallout particle emits a mix of gamma rays and x-rays plus alpha and beta particles. Only the strong x-rays and gamma rays have the penetrating power to go through the few inches of wood usually found in most frame homes. Gamma rays are a form of electromagnetic radiation and act like light in many ways, except that they can easily penetrate through solid objects. This fact explains why x-rays or gamma rays are useful in finding cavities in teeth or broken bones, thanks to their penetrating power. We usually lump the hard x-rays in with the gamma rays to keep it simple. Fallout particles emit gamma radiation in all directions, continuously, at a rate defined by the kind of radioactive elements in the fallout.

Protection Factors

Although gamma rays can penetrate many inches of matter, some gamma rays are absorbed or scattered, depending on the thickness of the shielding and nature of the material. A very dense substance like steel may prevent 99% of the gamma rays from penetrating through 6+ inches of steel. Only one percent of the gamma rays could penetrate such a shelter wall, providing a protection factor of 1/100th (pf=0.01). If only 10% of the gamma rays could pass into a basement shelter, then we would say that shelter has a protection factor of one-tenth (pf=0.1). If half the gamma rays get through a frame house, we would say the house has a protection factor of one-half (pf=.5). Obviously, the smaller your protection factor number, the less radiation that is going to get past your shielding and into you!

Best Shelters

The very best underground fallout shelters use 3 to 5 feet of packed earth for shielding, and have a protection factor of 1/500th or more (pf=.002). In other words, if a person outside would get 500 RADS of gamma radiation in an hour shortly after a nuclear burst, the person in the underground shelter with a protection factor of 1/500th would only get 1/500th of the outside dosage, or just one (1) RAD!

Dirt Cheap Shelter

Why are underground shelters usually the best fallout shelters? First, dirt has a lot of weight, or mass, so it strongly absorbs gamma radiation. Second, dirt is plentiful and cheap. From the list below, you can see why we say that fallout protection is literally *dirt-cheap*!

Dirt Thickness	Protection factor
16 inches	pf=0.1
32 inches	pf=0.01
48 inches	pf=0.001

Gamma like Light Rays

If you are out in the open, fallout on the ground (and structures) around you will be sending gamma radiation your way. Gamma rays act like light rays, except that you can't see gamma rays directly. If you could see this gamma radiation, you would see a "glow" coming from the ground all around you in a contaminated area. At first, the "glow" would be very bright, representing a high level of gamma radioactivity. Over the course of hours and days, this radioactive "glow" would dim and decline rapidly.

Hot-Spots
Some areas would glow brighter than others, due to *hot spots* or concentrations of fallout in that area. These hot spots could be caused by random effects, rain clearing fallout as dust particles out of the radioactive mushroom cloud, or perhaps winds or run-off down a slope. Unfortunately, we can't see or feel gamma or other fallout radiation. But I find it useful to think of each fallout particle as emitting a "glow" of gamma radiation in all directions - including my own!

Apartment Buildings
Now you can understand why the top floors of an apartment building are not a good place to seek shelter. Fallout on the roof would "shine" down on you directly below. Similarly, the ground floor would also be a bad choice for a shelter site. Fallout on the ground would also irradiate you directly from outside. Using this knowledge, you would likely guess that the best place to seek shelter in a multi-story apartment building without an underground basement would probably be on the middle level floors. Moreover, you would guess that the center of those floors would probably be the most desirable spot too. A floor with lots of steel filing cabinets filed with heavy papers would add further shielding to the building itself. We are just applying the principle of surrounding ourselves with as much mass as possible between us and all sources of radiation (including overhead on the roof).

Frame House
Let us assume you are in a rocky area (so you can't dig a hole) at an isolated frame house just a few hours downwind from a target site. A typical frame house has a very poor protection factor, often as little as pf=0.8 - little better than standing outside unprotected (pf=1). What can you do that would improve this situation? First, look for interior rooms, preferably ones without windows or direct exposure via a single wall to the outside fallout. Second, are there any natural shielding building elements, such as a closet, bathroom, or kitchen closet? Third, are there any spots with more mass around them? For example, a well stocked food closet filled with cans has a lot of mass in it. The kitchen next door may have a lot of appliances that are also relatively heavy. In such a scenario, you might select this inside area as your best available shelter. Using our *shelter within a shelter* approach, you could greatly improve this shelter site too.

Timing *Is* Everything!
I suggest that you realize that the first few hours or days after a nuclear burst provide the vast amount of radiation exposure (up to 90%). You simply have to be in shelter during this period to avoid a potentially fatal dose in many downwind areas. It is critical that you be inside a shelter rather than outside or exposed during this early, high radiation intensity period!

Shelter within a Shelter
If you have only a limited amount of shelter building materials, consider building a *shelter within a shelter*. Such a shelter within a shelter aims to gather up and keep as much mass as you can around you during these first critical days. For example, I might stack a door on top of my bed, pile it high with books, and surround the bed with boxes of canned goods, containers of water, and whatever else I could find that was heavy and sturdy. Now I might spend several uncomfortable days on bedding and a pillow under the bed. The extra shielding around me would probably reduce my exposure by another 50% or more. That's worth a few days of discomfort if you can avoid sickness or maybe a future cancer or two!
Improvements

Most shelters can be very effectively improved by placing mass around, as well as above and under if needed, if a rational manner. Try to think about and identify any spots where you have little or no shielding or protection. Provide additional shielding as you can to fill in these holes. Move a TV set, a piece of furniture, or other sturdy item into these spots. Cover and fill spaces with smaller items, such as cans, containers of water, a refrigerator, books and newspapers, or any relatively heavy or easily moved object.

Look Up!
Be sure to look up and evaluate your overhead protection. To reduce radiation from overhead, you can put a sturdy workbench or tables in your prime shelter area. You can stack materials on top of your table or workbench (but not so much that you get killed when it collapses on you!). If you don't have a table, you can make one using a door and some chairs or other supports. Appliances like refrigerators also make great supports and provide additional shielding mass too.

Dirty Tricks
Remember that dirt makes an excellent, cheap shielding material. In a single room shack, for example, you might pile up dirt in one corner of the shack, against the outside walls. This idea works best if you are far from the burst site and have some hours to prepare or improve an effective shelter, and easier if you have farm or other earth moving equipment. You could then use a table inside the shack, against that corner, to provide support for shielding above you, while packing stuff around you in this protected corner shelter. Such a shelter could easily be 50 or 100 times better protection than the original shack.

Leaning Tricks
Another shelter trick uses one or more doors from the frame house, leaned at an angle against the outer wall of the house or shelter. Inside the house or shelter, pile up shielding against the corresponding wall. Another trick is to dig up your house garden plants next to the house, assuming they are small and the soil is easier to dig and turn with a spade or shovel there. You can remove a foot or two or more of dirt in a trench against the house, circa 2 or more feet out from the wall. Now lean the doors over this trench, and use the dirt you removed to build up a packed shelter wall on the leaning door(s). Add more dirt as time and strength allows. You will end up with a triangle shaped shelter cross-section, as long as a door (or two), with a recessed trench and earth covered door shelter wall. You can put up some end supports to help keep the door from slipping if needed. Remember to pack some sand-bags (pillowcases?) or other shielding to close off the open ends of your shelter.

Trench shelter
The trench shelter is a variation on the leaning door shelter, but assumes you have the time or equipment to quickly dig a suitable trench. Put one or more doors over the trench, sideways if need be, to cover the hole and provide a support to pile dirt on top of the door(s). The doors come in handy again as sturdy and available supports for packing a depth of 2 to 3 or more feet of dirt on top of the trench. You can also use boards or any other sturdy support that can bear the weight of several feet of earth over the trench. Use sandbags or pile up dirt in the entrance area. Remember to leave a small air circulation hole or two. Keep in mind that it can rain during days or weeks of a shelter stay. Make sure you put in drainage ditching as needed to keep water from running into your shelter too. The trench shelter is very high protection factor, since you are effectively below ground and have 2 to 3 feet of dirt shielding overhead as well.

Car Shelter
Unfortunately, cars are not very good shelters, due to the use of plastics and thin metal which provides minimal shielding. However, if you are caught in the open with just your car, you can use it to also make an effective shelter. Note that nuclear explosion's electromagnetic pulse effects may destroy your car's electronic fuel injection circuit, turning your car into a unstartable junker. So you might as well use it to save your life. You can use the slit trench idea described here, but position your car over the trench in place of the suggested boards or doors. The engine is obviously more massive than the trunk, and can provide some useful shielding. You can pile up dirt underneath the car, as well as in the car's trunk and internal areas.

Root-Cellars
Many Americans have storm cellars or root cellars on their properties in the mid-west especially, due to hurricanes and tornado threats. Obviously, such a partially or fully underground structure offers many advantages as a fallout shelter. Usually, improvements to the shielding of the sides and top of these shelters are sufficient to make them into outstanding fallout shelters too.

Basements
Basements vary greatly in the amount of shielding and protection they will give as fallout shelters (e.g., pf=.1 to .6). You can greatly improve that shielding by using some of the tricks and ideas in this article. For example, you can use the steps leading down into a basement as a sturdy structure on which to pile additional shielding, and take refuge under the basement steps. You can move and pile up as much shielding on the floor above the basement shelter area (i.e., that corner). Most basements are filled with heavy boxes of stuff that is just perfect for use as fallout shielding material. Maybe that's why all that stuff is being saved down there! You can use the leaning door or sturdy workbench ideas to provide additional shielding.

I would also like to contrast two situations where our rules seem to differ, but really don't. In an apartment building where you are above ground, you position the walls and floors above and below you to form a shelter around, over, and under you. In the basement or where you are underground, you only have to worry about fallout radiation coming down at you from directly above or through windows or unprotected (i.e., unburied) sections of basement wall. By picking a underground basement corner, you would have maximum protection from the dirt and walls around and under you and at your back. You would probably add most of your protection above you and to the unprotected sides facing out into the basement central area. You would also reduce the radiation coming into the center area of the basement by blocking up windows. Piling up dirt around the basement would also be another way to improve its effectiveness. Moving heavy items on top of your shelter area on the floor above would also help provide overhead protection. So the main principle of surrounding yourself with mass is the same in both cases. But in the basement corner, you are already surrounded by dirt or concrete below and on two sides. Focus your worries about radiation from above, and from the unprotected open sides around you. Make sense?

Garden smart
Lots of folks also have flower beds or gardens near their basement or homes outer walls. These dirt embankments can greatly increase the protection factor of the internal basement by providing more shielding. The problem usually lies in the upper part of the basement walls which lie above the surface. Dirt embankments for flower beds and the like will help cover up such holes in the basement's shielding. It is also very helpful to have sufficient sandbags or shielding to put into any windows which are in your basement. Obviously, the window glass does very little to impede gamma radiation entry into your basement. Put up heavy bags of dirt, canned goods, books or other heavy items into these windowsills to help reduce radiation entering through this opening.

Stairwells
In many cases, stairwells provide additional mass and a sturdy support for a temporary shelter. Pack stuff on the stairs and sides, and you are set. Some buildings have concrete stairwells that are very high protection factor zones. Internal walls and stairwells may provide additional shielding too. A concrete car parking facility might be a possible shelter site, but an under the stairs shelter would probably provide the best least exposed shelter in such a facility.

Overpasses
Overpasses are basically tunnels into the earth with large openings at each end. Depending on their length, they may provide a very useful shelter site, especially if you are trapped away from other sites. As you might expect, the center of most overpasses near an under-earth wall probably provides the most protection. Cars parked or moved into a semicircle in such a shelter might provide extra protection too.

Drainage Pipes
In your efforts to find a quick underground shelter, don't overlook drainage pipes. In many cases, these metal or concrete pipes provide a pretty high shielding factor on their own, especially when buried as is often the case. Even if the site isn't ideal for a two week stay, you might find one offers the best protection in an otherwise open area. A few days spent in such a shelter is likely to make even Motel 6 look great, but will likely beat most above ground shelters. The main concern is that there not be any active drainage or use during your residency, especially if this means fallout will get washed into your shelter area.
Mines, Caves, etc.

Again, any underground site such as a mine or cave is simply a natural for a fallout shelter, especially if you can bring enough supplies to make it habitable for a full 2 week or longer shelter stay.

Why a 2 week shelter stay?
Why do most civil defense publications recommend a two week shelter stay? Consider our rule of 7 and 10. A 1000 RAD/hr at one hour after a burst dose rate will decay to 100 RADS/hr in 7 hours, 10 RADS/hr in 49 hrs (2 days), and 1 RADS/hr in 14 days. To get another ten-fold reduction to 0.1 RADS/hr, you would have to wait about 90 days or 3 months! That's a lot of supplies to store. Still, waiting four weeks will drop that 1 RAD/hr rate down to about 1/3rd RAD/hr - a worthwhile change if you have the supplies and patience to wait it out.

Shelter Related Issues
Creating or finding a shelter is only a small part of the battle. Living in your shelter for at least 2 days and preferably two weeks or more is also critical. Naturally, you will be way ahead if you setup and prepare and stock up now, after reading this, than if you wait! ;-) But if you have to prepare a shelter fast, here are some critical ideas to keep in mind.

Air Circulation
Contrary to general belief, you can't just tape yourself up into your shelter to keep fallout on the outside. You need to have some modest amount of air turnover and flow into and out of your shelter. Most shelters will do this naturally, and the required openings and air flow aren't large. But you don't need a wind tunnel effect either ;-).
The ideal method for circulating air would use a commercial air filter with hand pump designed for fallout shelter use. These pipes have screens and conical caps to help keep fallout out of the air and their piping. A cap inside the shelter can close the pipe opening if you are in the outer blast zone, or if a fire happens over the shelter site.
Unfortunately, the vast majority of emergency or prepared fallout shelters won't have such an air filtration system. Air will circulate naturally in most buildings and shelter structures, if modest air circulation paths are provided. Prevent air-borne fallout dust from blowing directly into the shelter. Any path that would cause dust to get trapped or precipitate out, such as turns or dust traps, will also prevent fallout contaminated dust from circulating into the shelter. When you setup these air circulation holes or pathways, don't forget that you still have to provide shielding for the shelter at those points too. Extra sandbags or shielding material around or behind these openings may work.

Water
Water is one of the most critical items for making a successful shelter. If you don't have enough water to survive at least 2 or more weeks in your shelter, you will probably come out into a contaminated area to get it. So it is critical that you acquire enough water or find it in an emergency.

Some water sources are obvious, such as defrosting contents of your refrigerator. If you have a flush toilet, you probably have some gallons of water accessible in an emergency. In some cases, you can still get water out of your home's pipes after water services have shut down. Close service to any outside water mains, if needed, to prevent water from draining out that way. Open a faucet on the top floor to allow air pressure to enter the pipes, preventing a vacuum effect. Now open a faucet or pipe on the lower/lowest floor or basement. What water is in your homes pipes should now be available to you. Usually, this water source can supply a surprising number of gallons of water. Office buildings or other buildings with water service may also be tapped this way.

Lots of buildings have boilers to supply heat or steam or other services. These boilers usually have water in them and their associated pipes. The amount of water may be quite large and nearby, in the event you are stuck in an office building basement shelter.
At the risk of being obvious, many buildings and sites have employee kitchens or spots where water might be stored (along with lunches etc.). Naturally, soft drink machines are subject to raids for life giving needs.

The subject of post-attack water purification is important, but I can only touch on it here. Ideally, use a zeolite or similar brand water purifier as your last stage of water purification. A vacuum or micropore filter for removing heavy metals and related impurities from water, such as are used for travel in certain polluted third world cities and environments, is also great. You would probably need to filter out any bacteria and floating debris from suspect water supplies. A simple sand and cloth based filter is one approach, using 2 or more feet of sand filtering. If you had to use such water directly, you would want to kill off any bacteria and most viruses by boiling if possible. You can make the water taste less flat by moving it between several containers, so air gets absorbed by the boiled water. Another handy idea is to use some tincture of iodine or chlorine bleach (e.g., Clorox) in sufficient strength (5-6 drops per gallon) to kill off most germs. Be sure to give the chlorine, iodine, or bromine time to do its work (i.e. half-hour). The water should be clear and taste slightly like chlorine or bleach, but not excessively so.

Food
Food is obviously a problem. Most U.S. cities have only a few days worth of food stocks before they would run out. Most suburbs and small towns are almost as bad. Along with the availability of food goes the issue of preparation. Refrigeration is probably out, as is most cooking, especially in hot summertime shelters. Some food items go bad quickly (e.g., mayo), and adding food poisoning to radiation sickness is no joke.

It makes sense to first use up any readily available frozen foods which are in sites where power has been lost to the refrigerators. In general, it is best to minimize the number of times you open a refrigerator to maximize the freshness of food therein. One source has recommended turning the refrigerator on its back so cold air stays trapped inside when you carefully and slowly open the door. Defrosted ice slush and water are also less likely to run out this way, and might be scavenged in a pinch.

Intermediate foods like fruits, breads, and other items subject to spoiling should be eaten relatively quickly. Since fallout is dust, you can help keep it out of food by keeping cans (and can openers) clean, opening cans from the bottom, and carefully dusting off packages before opening. Fruits in refrigerators and other enclosed containers are probably okay, and peeling fruits will greatly reduce the chance of fallout contamination. But some leafy vegetables may be a poor dietary choice in the post-attack environment, unless lots of fresh water is available for cleaning.

Canned goods have very long shelf lives, so they would be usable at any time. Unlike water and air, you can survive for days or longer without food. So suppress those big-Mac attacks in the middle of a nuclear attack! Hunger pangs will be worst during the first few days of any diet, but quickly less thereafter. Eating what you have in smaller meals and more often is also recommended (shrinks stomach size and hunger pangs). As an inactive adult in a restricted shelter area, you will probably need much less food than your normal active lifestyle requires.

Sanitation
Sanitation is another shelter related problem. The same bottle of bleach that might be used to purify water can also be used to kill germs. Some improvising can convert an office trash can into a fallout shelter toilet. Magazines, Sears catalogs, and newspapers have served as toilet paper in our nation's past, and may again. Those plastic trash can bags from the home or office can be used and reused with ty-raps to simplify waste disposal. Pesticide sprays may also be available and handy. A wet towel can be kept wet for washing by putting into a trash bag and sealing it shut to prevent evaporation. As vomiting is a common sign of radiation sickness, you should expect such problems by having barf bags available. Be sure to address dehydration issues from such symptoms. Finally, don't soak up a lot of RADS during the early post-attack period just to get to a real bathroom. Messes can be cleaned up or washed off later, but you can't unload that extra radiation exposure so easily.

Temperature
A shelter can be too hot or too cold, depending on location and local climate. Some thought to providing blankets or clothing or other insulation is clearly useful. Speaking of cold weather insulation, I can vouch personally for the use of newspapers as great insulators from some snow survival camping courses. Most heat is lost through contact underneath the person in cold weather, then from the head and extremities. Hot weather is harder to handle, except with increased air circulation, but most shelters are usually either underground or inside where it is cooler. The importance of adequate water sources is even more critical in hot conditions, although use of salt and conserving movement until evening is usually helpful.

Beds
Beds are where and how you make them. An under the table shelter might use just a mattress. A trench shelter might use some strategically dug holes for the hips and shoulders plus some newspaper insulation. In an office building, you might make beds (and stretchers) out of shirts strung and buttoned over two broom poles laid out between chairs. Chairs may work too, or even the floor if sufficiently exhausted. ;-)

Iodine
I would probably be remiss if I didn't remind you that iodine is one of the major dangers during a reactor accident. Iodine has a gaseous transfer mode, so it can rapidly spread and contaminate a large area quickly. Release of radioiodine is dangerous because iodine is preferentially concentrated in the thyroid gland. The radioiodine builds up and irradiates the thyroid, causing cancers and other problems.

A partial solution is to take non-radioactive iodine tablets. Unfortunately, you may not find these at your local drugstore. After Chernobyl, the value of such tablets is beyond doubt - except to the certain (ahem) governments who are afraid of causing a panic by stocking them. Special order yours now and avoid the wait. You can possibly benefit by using iodized salt in a pinch (pun intended). Some vitamin supplements, especially kelp and seaweeds, are iodine sources. This iodine issue is another reason to consider using tincture of iodine based water purification methods too.

Vitamin and Mineral Supplements
Related to radio-iodine are the other "bad" radioisotopes that mimic other body needed elements (chiefly calcium as used in bones and teeth), and so get picked up from contaminated food and water. Radio-strontium and radio-cesium are two major examples. As with radio-iodine, providing a large stock of calcium before and during exposure can reduce the uptake of these radioactive alternates.

Besides digestible calcium tablets (with vitamin D or other uptake enhancers), you should also look at a broad spectrum mineral and vitamin supplements. Diets are likely to be proscribed after an attack, radiation damage will need to be rebuilt, and vitamin and other supplements have a role to play. Finally, some of us may be taking mega-doses of free radical reducing vitamins such as vitamin E and C as well as selenium and other supplements during and into the post attack period. I caution that whether such free radical scavenging vitamins and minerals will reduce the effects of radiation ionization is not fully studied. However, vitamins are well regarded for stress situations, such as shelter living, whether they have any other benefits or not.

Radio
Emergency Radio Setup
A number of moderately priced flashlights and radios with integral hand cranked generators are out on the market for campers and boaters. They also make an excellent item for shelter users. Most modern radios with short antennas will probably survive a distant nuclear electromagnetic pulse event, especially battery powered VHF FM radios. Any TV or electronic item hooked up to a longer antenna or power cord is probably going to get destroyed, unless it uses all vacuum tube designs. An AM band radio or shortwave option would also be handy. Some TV-audio radios are also a good choice under many conditions for local fallout and weather forecasts.

Nuclear electromagnetic pulse is an immediate effect from larger nuclear weapons which acts to destroy electronic devices at great distances with a lightning-like zap effect. You can improve the chance that electronic items will survive a nuclear electromagnetic pulse by disconnecting power cords, antennas, keyboards, or other removable wires that could conduct this pulse into your electronic equipment. Close any extending antennas on portable CB or FM radios too. Old tube radios and portable VHF radios tend to survive better than shortwave or transistorized equipment (including computers). A Faraday shield of conducting metal all around a stored, backup electronics item such as a GM counter may help it to survive Nuclear EMP. Many older civil defense radiation detectors use tubes, and might also survive EMP better as a result.

Lighting
Providing light in most shelters is a tricky issue. Candles use up oxygen and represent a fire hazard, a major safety issue for most shelters. But they also give out a lot of heat, and would be most welcome in many winter or cold weather shelters. A car battery pulled to immobilize a car or truck could also be used to provide light and power in a small shelter. An adapter can be used to run most radios. Some low power LED or bulb lights would be a good way to stretch a battery's limited power reserves.

Tools
The key tools to discuss here are the ones needed to make a shelter, and to get or dig out of one in the event of a problem. Items like pry bars, shovels, rope and tackle, and similar tools could be very useful. Nails and a hammer could be used in building a temporary lean-to or other shelter.

Radiation Monitoring Instruments
Radiation monitoring instruments fall into two classes. One set of instruments provides you with the current dosage rate in RADS per hour. These instruments include survey meters using ionization chambers, and Geiger counters using GM tubes. Specialty instruments can measure alpha radiation, neutron doses, and very low level radiation (e.g., scintillations). The second set of instruments are called dosimeters, and they accumulate your radiation dosage exposure over time as absorbed RADS or REMs.

Which one should you get? The geiger counter is great at low radiation levels, but only a few dual tube military/commercial units have a useful range in a post-attack environment. The military surplus AN/PDR-27 GM unit has a gamma/beta hand probe GM tube and internal tiny ceramic GM tube for high radiation levels. Most civilian uranium prospectors GM counters are too sensitive for high level monitoring. Even the surplus OCD CD-V717 series Victoreen GM counters are mainly for low level environments. Incidentally, pack a supply of baggies and rubber bands along with spare batteries if you buy a GM counter. Put the baggie over the tube, and rubber band it on, in a clean environment. Now when the tube gets contaminated, it is easy to pull off the baggie and decontaminate the tube. Two baggies may be better than one, but they also reduce beta sensitivity greatly. The latest solid state detectors are small, lightweight, and battery powered, but often much more costly than a surplus unit.

The usual high level survey meter (OCD CD-V700 series Victoreen survey meters) works great for most post-attack environments. The upper range is usually well into the lethal level of contamination, while the lower end may overlap the GM counter's upper range. Batteries may be a problem, so stock up. Be on the lookout for a special, split instrument version that had a survey chamber on a long cord that you could put outside your shelter. The idea was you could monitor the actual outside radiation levels directly, reading the chamber remotely through a long coaxial cable. You compared that reading with another survey instrument inside your shelter. Among other things, this comparison gives you your shelter's effective protection factor, which is only estimated otherwise. It also tells you the actual radiation levels outside the shelter, without having to go out and get contaminated in the process to find this out.

Dosimeters are also usually found in two flavors, low and high ranges. The low ranges are often very low (mili-REMs), as they are aimed at civilian radiation exposure limits. The more useful post-attack dosimeters are those OCD/military surplus units designed to measure exposures in REMs (or Roentgens in the earlier units). At the high end, the level hits 600 REMs accumulated doses, equivalent to a 90% fatality rate dosage. At the lower end, the dosimeters are useful for the low single digit REM levels likely some months after an attack. Be aware that dosimeters need specific high-voltage chargers (battery-powered inverters with 100-150 volts or so outputs) to make them work, careful record-keeping, and sometimes special reader setups. Other units can be read by the user simply by holding up to the light. Keep them clean to avoid leakage currents (and higher readings). Usual practice is to wear multiple dosimeters, typically at least three, so if one is bad, the other two will indicate correctly.

Sources for new instruments include scientific supply houses (for schools or labs) and military and commercial nuclear power suppliers. Surplus units are much cheaper, whether from surplus civil defense or military sources, but may use hard to find batteries or battery-eating tube filaments. All of these surplus instruments can also be purchased at EBAY online auction, weekly, at http://www.ebay.com - running from $25 US to $50 US and up. Most EBAY advertisers have no idea what they have acquired, which is usually from locally surplus civil defense stocks. Most *geiger counters* offered for sale are actually survey meters, so check and bid accordingly. The later models are much easier to find batteries for than the older units, which often used rare high voltage batteries.

Masks
Air particles are more of a problem than might appear. Some post-nuclear attack models suggest that there is going to be a simply terrific level of air pollution from the thousands of square miles of fires incident to a nuclear explosion in a city area. Much of this pollution will be the toxic burnt plastic carcinogens already familiar to chemists, but on a truly gigantic scale. Tests with the U.S. Forest Service have involved simulating nuclear firestorms with square miles worth of cut-down trees. Those studies suggested that while firestorms were less likely than expected in U.S. cities, the number of small fires might be much higher than previously expected. So masks may be a good idea, if only because of the pollution problems you may not have thought about.

As for radioactive dust particles, some masks do a decent job at removing many sizes of dust, but not all. Masks for filtering aerosol paint sprays probably won't be optimal for many radioactive particles, especially farther downwind. Many of the long-term post attack survivor deaths are slated as the result of inhaling, ingesting, or wound uptake of various alpha and beta particle emitting radioisotopes. So here is another reason for shopping early if you share this concern.

Weapons
The good news is that most of the drug addicts and crazies who are wandering around in a high radiation zone will be dead long before you leave your shelter. Most people will be sick and traumatized, and probably in deep depression after such a nuclear catastrophe. Weapons may be more of a danger to shelter inhabitants during the stress and grief of traumatic shelter stays than to outside threats. Still, I can't make this choice for you, so do what you think best. If you do elect to get weapons, please take the safety training that goes with them too.

Seeds
Commercial agriculture is a complex business with many critical inputs such as petrochemicals, fertilizers, and seeds needed to get the desired outputs. A breakdown in the economy, in fuel sources, chemicals, or other inputs could result in widespread followup famines, compounded by food processing and distribution problems. Against such a possibility, some folks have elected to pack away various seeds and agricultural tools and resources needed to take up limited family survival agriculture. Seeds are a necessary element in any such program, and relatively compact and cheap for family scale efforts. Buying from agricultural sources rather than retail packages might provide further savings too. If you are planning on surviving using this route, consider getting some experience now by growing a "victory-garden" for practice and profit, or at least for some fresh veggies.

If you don't plan on this route, you had better plan on stocking up a lot more bulk wheat, a grinding mill, and other cheap grain calories to last you a few years until agriculture gets back on its feet after a major nuclear exchange. Both approaches would also work even better, hoping to survive on local plantings but ready to stretch out food stocks if needed. Moreover, while bulk grains provide lots of cheap calories, you will still need and want the benefits of having fresh vegetables. A relatively small garden plot can provide a surprising amount of tomatoes, carrots, squash, and other treats.

Special Needs
I haven't hit on any special needs you or your family members may have, but you need to consider these carefully. For example, you may need lots of dehydrated milk powder if you will have children with you in your shelter. An older adult might need several spare pairs of glasses to see effectively. A hearing aid user might need special spare batteries. You may need special medications or other supplies. In short, take note of any special needs and plan and store resources accordingly. Try to think ahead and anticipate likely needs too. Use the Alpha Strategy to locate and buy needed items on sale, at thrift stores, or other budget sources.

Odd-Ball Items
This category is just to catch those items some of us want to add to the usual civil defense basic listings of shelter items. For example, you might feel that a compass and fish-hooks and lures and line is a must-have. By all means, buy it on sale if you can and store it. Keep your mind open as you visit malls and stores, get catalogs in the mail, and otherwise encounter interesting items or good buys.

Proactive Medical Care
Consider becoming more proactive with your medical care. For example, when was the last time you visited your dentist? That's too long!! How about a medical checkup? Does your medical plan cover it, and if so, why not benefit from it. At best, you might uncover a condition or illness early, when treatment is more successful, and possibly even save your life. At worst, you may lower the cost of treatment by going more often to the dentist and doctor. To be blunt, you don't want to be putting off some necessary dental or medical work. Imagine a month long stay in a shelter with a major toothache! Even worse, with perhaps 90% fewer doctors and dentists around, you might have to wait weeks or months to get treatment. Facilities could be lacking, and materials for operations or dental work may be exhausted early on.

While you are in your doctor or dentist's office, consider requesting a spare set of your medical records, and that of other family members, just in case you should need them. Store with family and other records in your shelter, preferably in a fireproof box where you might keep your other important records in a very safe place. You may want to review your vaccination history and see if there are any shots you need to get updated. A tetanus booster may be useful and worthwhile. Some county health agencies offer free or low-cost shots for travelers or during flu seasons.

Money
It may seem silly to talk about money at a time like this, but you may want to have some available (e.g., stock up at any convenient ATM). Money is a medium of exchange and a store of value. After a single terrorist burst, having money in hand might be useful during exit from the contaminated area.

Even after a war, many folks will be unable to make the mental leap that paper money is worthless and exchange something useful for it. Records are likely to be so disrupted that you won't be able to get funds from bank accounts, let alone credit cards. The good news is that the IRS has preprinted 50 million forms for us to use in requesting delays in paying our taxes because of nuclear war (no kidding). So you may find a use for those greenbacks after all.

Real stores of value such as precious metals (e.g., gold coins, silver, or platinum ingots) or gemstones are obviously more useful. The coins are better recognized and don't need to be tested or assayed. Gemstones are for starting over and carrying assets in the most compact form possible. But it would be hard to get change for a diamond or gold coin, so small value coins and silver coins are recommended by some sources.

Food is too bulky and spoils too easily to serve as money. Trade goods such as tobacco and lightweight barter items such as sewing needles may or may not act as money depending on local needs and circumstances. If I had to guess on a post-nuclear war universally acceptable form of compact and lightweight value, besides gold, silver, or diamonds, I would pick pain killers and antibiotic drugs. This approach has the benefit that these drugs can be very cheap now (unlike gold or diamonds), may have long storage lives, and are intrinsically useful too.

Medicine
The need for medicines and medical care is likely to be much higher in any large-scale post-attack situation. Roughly 90% of all the M.D.s and especially surgeons in the U.S. reside within the blast target zones, as do most of the major hospitals. Even a modest sized nuclear explosion in a U.S. city would generate hundreds of thousands of burn victims, few of whom could be treated. Since radiation reduces the body's ability to fight off disease, many endemic diseases will become rampant in some post-attack scenarios. I will be optimistic and assume no biological agents are used. Still, the need and value of cleaning agents and common antiseptics and medicines will be greatly enhanced.

Again, the scope of the problem is outside what we can review in detail here. My best recommendation would be to get some of the more advanced civilian medical aid books, such as those used by boaters - the *Ship's Medicine Chest and First Aid at Sea* being a good example. These books show and tell you how to deliver a baby, sew up a puncture wound, and remove an appendix, as if a doctor isn't or can't be present on the boat. These first aid at sea books have much more detailed listings of resources for the isolated group to acquire, and why. You may need a sympathetic physician to provide access to some of the needed or recommended drugs and materials. These books also discuss many common minor operations that can be performed, and how to do them, as if the person were isolated and needed treatment at sea. Red Cross style training may have some value, but there may not be many post-attack clinics or hospitals available to provide follow-up treatment or care.

Shelter Emergency Entrance and Egress
Deciding when to enter a shelter may not be easy. In many terrorist or other nuclear incidents, you simply won't have any warning. Again, this reality puts a premium on prior shelter identification and preparation. What if you hear of coup attempts in nuclear states in the former CIS or similar troubles? It may be time to leave target areas and seek or setup a shelter site if you don't already have one.
You might consider sleeping in the shelter during periods of high tension, rather than discover your power is out and you just absorbed a fatal dose in your sleep. During the day (or night), consider leaving radios or TVs on. I am not suggesting that the US authorities will actually manage to get out a warning, although they might. But the EMP from other nearby hits may provide very limited warning and confirmation of a possible nuclear exchange. You may hear a series of lightning like crashes on audio and static on TV screens, and may lose carriers from direct (non-cable) stations. Power may go out, leaving only battery powered radios or TVs sounding their EMP static burst alarms, each one registering the death of a city or military base. Get indoors or inside immediately, away from windows and glass and below ground or into the shelter area immediately if you can.

During a period of high tension, you can also make such local preparations as last minute food re-stocks, gas tank filling, ATM withdrawals, and so on. Depending on your distance from prime targets, you may want to close and tape curtains, remove dark drapes, and remove flammable materials like leaves and boxes from near your home or shelter. Extra water might be stocked in buckets or containers to use for fighting fires if you are in fire starting range (30 miles) of a nuclear thermal pulse. You may want to build or extend a layer of dirt around your basement shelter, or prepare and move bags of dirt into exposed basement window sills, if this fits your shelter situation. If you are over 30 miles from a possible target, you will have more time leeway. The more tasks you can complete now that might require outside work to prepare your shelter, the better.

Assuming you have a radiation detector (GM counter), you can directly determine the time when fallout first begins to arrive (which time should be carefully noted, as well as the time of the nearest burst(s). Lacking radiation instruments, you might get word from local emergency broadcast radio sources. The farther you are from the target site, the longer it will take the winds to carry fallout to your area. Near the burst site, you may be able to directly see fallout coming out of the sky as a fine dust, grit, or ash. Try to avoid exposure to this fallout dust (particularly breathing it in or in burns or wounds). If you can't, take great care to remove as much of this fallout material from your skin, hair, clothes, shoes, and person before entering your shelter area.
When is it reasonable to leave the shelter during the early fallout period, and for what reasons? The only reasons to leave a shelter during the high radiation level early fallout period is a life-threatening problem. Examples would be flooding (drowning), fumes or smoke (can't breathe), and fires. Fires are unfortunately quite likely after a nuclear burst due to the thermal pulse, at great ranges (30 miles or more) from large bursts. These initial fires will also spread in the direction of prevailing winds, especially if dry conditions make forest and ground fires possible. Unless such a fire(s) directly threatened shelter existence, it would be better to remain in the shelter than absorb a lethal dose of radiation by fighting the fire.

The scope of this problem will vary widely, depending on location, weapon size, and combustible materials on-site. Choices of light curtains rather than dark will probably prevent some fires from starting. In other cases, blast waves and gas pipe breakage will start many fires. Consider shutting down gas service in the pre-attack warning period. Fill all water containers and sinks or tubs for fire fighting and shelter use. Consider shutting off home water service, if not on a well, so as to retain uncontaminated drinkable water in your home's pipes.

At greater distances, human errors and panic will probably start most fires. Individuals can do best by being prepared for fire, meaning tools, water or sand, and fire fighting equipment is at hand. Like many nuclear scenario suggestions, this idea will enhance your regular personal and family safety. Still, it may be necessary to fight and put out any fires that start in the shelter structure.

Some shelter studies suggest checking the shelter and its area, after the burst, and putting out any fires that are encountered before seeking permanent shelter. If you are facing a single terrorist weapon burst, that may be good advice. But if you are facing a rogue nuclear submarine launch, that may not be a good idea. The problem is that many nuclear weapons are targeted against each target, to ensure redundancy and utter destruction of the target.

What if you are outdoors fighting fires from the first burst, and a second or third burst goes off? You are likely to suffer burns, possible retinal damage, and other effects even 30 or more miles away. If you must go out, be sure to wear light colored clothing, cover up all exposed flesh including neck, head, face, hands, wrists, and ankles (e.g., with light colored tape and layers of cloth). Even if you try to avoid looking at the likely target site, you may get blinded by a reflection or involuntary response. At the least, consider the old SAC nuclear bomber pilot trick of using an eyepatch. That way, when your first eye gets blinded, your second eye will still be able to see.
Floods are also another valid reason to switch shelters, but much less likely in most shelters than fire. Heavy air pollution or smoke that renders air literally unbreathable might be another rare reason to move in the first 48 hours. But in general, most other reasons for leaving shelter before 48 hours have passed are likely to be bad ideas. Thirst and hunger can and should be withstood for as long as possible. Even a few hours could make a difference between fatal and near fatal radiation exposure levels. Lack of bathroom facilities or discomfort from cold or heat would also not be a valid reason for leaving shelter during this early period.

Once you reach the 48 hour plus point, it is at least conceivable that you could leave shelter for a short period of time without a fatal or illness inducing dosage being accumulated. This egress should preferably not be out into the open but maybe into a nearby, still somewhat sheltered area of the same building. Water and possibly food would be the major reasons for leaving shelter in the 2 day to 7 day period. After that, short trips might be feasible in many sites. Naturally, if you are in a barely contaminated zone, you can be more lenient. I am mainly concerned here for those relatively close to the burst and higher radiation areas.
Conversely, you may want to remain in shelter beyond 2 weeks, even beyond a month, if your shelter stocks and situation warrants. This practice will minimize your exposure to external fallout radiation. You will also minimize your uptake of radioactive particles through inhalation, ingestion, imbibing, or other uptake mechanisms (e.g., through wounds). After circa 200 days, much of the fallout would begin to weather and get complexed and bound with the soil at a non-linear rate. Dosage rates would fall dramatically below projected models. However, this long stay option is only available to those who either plan ahead or are very fortunate in their choice of a sheltering site.

Shelter Transition
Assuming that you are not forced out of your shelter prematurely by an emergency such as fire or flood, you should maximize the value of your shelter during the transition period. At first, you will probably only need or want to make short trips out of the shelter, in light of the still high radiation levels in most areas. Consider that a civilian lifetime radiation dose is 5 REMs. Even after two week shelter stay in a hot zone (initially 1000 RADS/hr), you would get the same 5 REM exposure in just 5 hours. In such conditions, you would probably be advised to move quickly out of the highly contaminated area to more distant and much less contaminated sites. You would wait in shelter as long as possible in order to minimize your dosage during the exiting time period.

Naturally, I am having to make some assumptions here about the nature of the post-attack or post-accident environment. If a single low yield atomic device is detonated by a terrorist, the situation is quite different than if China's 13 ICBMs targeted at the U.S. are launched in error or by design. If even a single MIRVed missile were launched at U.S. cities by a rogue Russian submarine, the direct effects devastation would kill millions of people within a few hours. Tens of millions of people would probably die from downwind radiation doses over the course of weeks and a few months. The U.S. economy would probably be completely disrupted, much agricultural activity would cease, and many systems would break down in the ensuing economic and environmental chaos.

Even people outside the U.S. would die in surprising numbers, due to the collapse of U.S. agricultural exports and various medical and pharmaceutical shortfalls, as well as the disruption of the collapse of the U.S. economy on the world markets. Dollars might be worthless overnight, and most export economies would crash quickly too. The possibility for developing virulent strains of old as well as new global pandemic amongst the pools of weakened survivors, in an irradiated environment, is also a possible source of external deaths. Above a certain level, the potential for a nuclear winter scenario would also have global implications. There is also the expected longer term fallout from the stratosphere on a global scale over months and years, expected mainly in the Northern Hemisphere. In short, any U.S. nuclear bursts would be likely to have unanticipated impacts on people and systems outside the immediate target zone. Chances are that many of these effects haven't been anticipated yet, but will only be observed or understood after the fact.

Even if the radiation levels have fallen to 0.1 RADS/hr, that still means you will accumulate that 5 REM dose in only two days outside (50 hours). So chances are great that you would want to minimize your exposure to only an hour or two a day even at these seemingly low levels. The rest of the time, you would want to be in an effective shelter (pf=0.01 or better).

A delicate question arises over who should go out during these early higher radiation excursions. The general recommendations are that those of child bearing age, especially women, should be minimally exposed to radiation. Children should also be very limited in their exposures, due to their greater susceptibility to radiation and uptake of radio-isotopes to form bone (e.g., radio-strontium). So it falls to the older, post-reproductive members of the community to make the higher-exposure trips. In part, the older members will also have fewer years to develop and express many forms of cancer that are likely to kill the younger members with similar exposures.
One major issue is going to be minimizing contamination of the shelter and surrounding areas. The usual concept is that you have a clean zone and a warm zone, leading to the outside hot zone. At each zone to zone interface, you have a monitoring station to ensure and minimize contamination. The warm zone might be a lower floor under a middle-floor apartment building shelter area, or the first floor above a basement shelter setup. The vast majority of any fallout radiation would be removed before crossing from the outside hot zone to the warm zone. This removal would be by mechanical means, such as brushing off radioactive dirt and dust, or washing, or cleaning with solvents (e.g., tools), and similar procedures. Rubber boots and gloves, raincoats or other impenetrable clothing, and liberal use of tape and plastic might be needed to minimize transferring fallout from outside into the warm zone. The warm zone would also have less protection from surface (and roof-top) radiation, so it would be warmer too in that radiological sense, than the protected shelter area.
Great care has to be used to ensure that fallout contamination doesn't get into the shelter area or clean zone. As one example, the shoes used in the warm zone might be exchanged for clean zone shoes, along with changing clothes. Hair might be cropped short, and each person entering the clean zone subject to a thorough radiation check using a sensitive geiger counter. A GM tube with beta reading capability would be useful in this particular scenario too (as well as for food and water contamination checks).

After a few months, the rate of radioactivity doesn't decline very fast, so efforts may be justified to reduce these rates around living areas. To reduce the radioactivity in and around the clean zone shelter, some efforts might be made to wash away or remove fallout dust from the shelter environment. As one example, the external shelter could be washed down with soapy water. Sandblasting might be needed to remove contamination from concrete walls. Alternatively, after cleaning a painted wall as much as possible, it might be re-painted to lock in contamination. You want to keep radioactive fallout dust from moving into the clean zone or being inhaled by workers later on as airborne dust. Dirt and grassy areas would be either turned over in place (for low contamination) or scrapped off and away from the shelter site. This trick would remove most of the fallout with the top inch or two of soil far enough away (100 ft+) so that radiation levels would be much reduced around and inside the shelter. Dirt can also be piled up over and in front of this ring of contaminated dirt removed from around the shelter, serving as extra shielding and keeping radioactive dust from being blown about. Unfortunately, it is very easy to contaminate a clean zone or warm zone with a little carelessness or failure of procedures. Some clean zone contamination might be cleaned up, others would simply be too hard to remove. Many shelters will be in areas where windows were broken by the blast, weather, or vandals. The lack of windows will readily permit radioactive fallout dust to blow into the shelter site building. In such cases, the warm zone may be quite restricted to a minimal decontamination zone outside the main shelter. Some sources suggest that if time before fallout deposition permits, that windows and doors in the house or structure above the basement shelter should be closed or even taped up. Plastic sheeting could be taped over broken windows. Chimneys could be blocked as well. The idea is to reduce or prevent fallout from contaminating the building or areas near the shelter. Fallout is kept away from the floors above the basement shelter, and later decontamination is greatly eased and simplified. Again, remember that some shelter and building air circulation is necessary to support life.

But by keeping a relatively fallout-clean shelter and home, one could avoid much of the cumulative radiation dose during the longer post-attack period. After two years, the level of contamination would be sufficiently reduced that most areas could again be used with only minor or moderate restrictions.

Unfortunately, many areas would still be heavily contaminated, particularly those *hot spots* in which rain washed major amounts of radioactive fallout out of the mushroom cloud directly onto the ground surface. Run-off might also build up in certain areas, thoroughly contaminating that area too. Some areas near ground zero would also likely be highly contaminated. Contrary to popular opinion, many of the radioactive contaminants would still be a threat long after radiation levels had reached seemingly safe levels. Only a millionth of a gram of plutonium might be needed on a single dust particle to cause a cancer if inhaled by a passer-by. Such contamination of both land and food chain habitat will present a challenge in the post-attack environment. In some cases, these sites will have to be abandoned for decades, perhaps even centuries, part of the legacy from the nanoseconds of nuclear detonation.

Planning Ahead

You can approach preparation for a possible nuclear incident at several levels. Just reading this page has probably provided a quick introduction to many issues, some useful ideas, and things to think about. Good! Now the question is whether you decide to act on what you have learned or not.

Fortunately, a great deal of the real preparation for a nuclear incident has direct benefits and dual uses. For example, you increase the food stocks in your home by buying on sale. See Pugsley's The Alpha Strategy book on how this approach can save you up to $2,000+ per year, and more than pay for all your other preparation efforts to boot! Tobias' popular book, The Only Investment Guide You Will Ever Need also suggests that the only way to make money in commodities is to stock up on soap and food and the like at your grocery store while they are on sale. Doing so will lock in a guaranteed 20% and up return on your investment. In short, these books and ideas will make you much more secure in the event of a wide variety of problems (riots, bad weather, trucking strikes, nukes..). Best of all, you can stock up on whatever you need now, save lots of money doing so, and be ready just in case.

Pugsley's Alpha Strategy - Be Prepared and Save Money Too!
Pugsley's Alpha Strategy is a simple plan that starts by buying items on sale and building up your stocks of foods and household supplies. Since you are buying on sale, you will save 10%, 15%, 20%, even 25% or more on these items. But you also save time since you have to make fewer trips to the store to buy single items like soap. You just pull from your stocks, and replace at the next sale. You also save on gasoline with fewer trips, and buy less impulse items you don't need too. Over time, you will build up a stash of food and household items, perhaps even tools and clothes and other non-perishables, using the Alpha Strategy. In the event of a crisis, a terrorist attack, or a trucking strike, you can safely stay at home and avoid the riots and crazies running around. You have lots of food stocked away, and most items you might need, all purchased at sale prices. In a nuclear attack scenario, the Alpha Strategy approach means you will be stocked with at least two weeks worth of food and beverages and stocks to survive during a shelter stay. In short, using the Alpha Strategy makes your shelter preparations not only sensible but also profitable as a way of saving money. Even if you never have to take shelter for any reason, you still come out way ahead. And if you do have to take shelter...

A relatively cheap way to store large volumes of water, in a convenient way, is with a waterbed (plus bacteria inhibitor) in a basement shelter site. You can sleep on it when you are in the dog house with your spouse, and you can sleep on it and drink it in the event of a nuclear incident. Don't like waterbeds? How many PEP plastic bottles do you drink and throw out each month? A drop or two of chlorine bleach and some fresh water, and a box to stack them up in, and you have beat your water storage problem at no cost.

A few gallon bottles of water in the car, in case you get stranded, is a good idea and low cost option too. Say its for the radiator if it overheats. The same idea can be advanced for everything from some tools, to a radio, to batteries, lights, some food, and blankets. Everything needs to be in a quick grab and carry bag(s). In short, I am suggesting that if you are a mobile person, you probably need a mobile set of supplies. Hopefully, you will never have to find and setup your own shelter, but you will likely find enough uses for these items to justify setting up your stash.

How much food you decide to stock in your shelter area becomes mostly an issue of space and finances. A single visit to a food co-op could provide a year's worth of cheap calories for surprisingly little money ($100/adult). While wheat can be bought in bulk and lasts for years with proper storage, be sure you have the required hand-mill grinders needed to process it into flour. Rice, corn, or other grains can also provide a year's worth of calories very cheaply. Salt, pepper, and other preservatives might be very useful in a post-attack environment, especially in inland areas. Vitamins are a cheap supplement compared to securing uncontaminated fruit and produce.

At the other extreme, you can purchase a year's worth of vacuum dehydrated prepared meals such as steaks, Swedish meatballs, and dried fruits from

various mountaineering and other suppliers. This option is the most compact and tasty, but also most expensive approach. A careful search of most food stores will let you identify and stock up on lots of dehydrated foods (like pasta, cereals) that cost a lot less per meal than dehydrated mountaineering packages or freeze-dried steaks. Still, some days worth of these meals might be a useful adjunct in your car or shelter stocks, as lightweight foods during a possible exit from contaminated areas.

For most of us, the best and most economical approach is to use the *Alpha Strategy* to build up our stock of normal foods to at least 2 weeks, and preferably more like 2 months of staples or more. Store your excess cans, pasta bags, and the like in the shelter area, and transfer as needed to the kitchen. Stock and store as much cheap rice or other staples in the shelter area as you can. Label food stocks by date on the container(s), and rotate to use as much as you can in normal use. You can always donate the still-good excess food to many soup kitchens or the like if you can't use it all in the usual storage period.

Once you get such a shelter supplies listing started, you will find most of the items have dual or multiple uses. Candles are handy if you have a power outage, as are flashlights. Rechargeable batteries save money, and let you have an extra few sets on charge ready to go at all times. A shortwave radio can be fun and educational. A high efficiency LED light from Radio Shack can be adapted to use with a surplus or older car battery kept on charge near the shelter. You don't need anywhere near the discharge amps needed to start a car for your surplus battery, so a worn out or cheap car or gel cell battery (preferred) will work fine.

A stock of tools and cleaning supplies is hardly a major expense, and can have obvious uses in a shelter setup. One point needs to be made, however, and that is that you need to ensure that you keep these items in the shelter when not otherwise in use. You may not have time to go find where you left the shovel in the midst of a nuclear accident or explosion.

One problem area for shelter stocks consists of fuels and volatile cleaning supplies. The first point to make is that you should keep your car's gas tank filled up, especially in troubling political situations. If you elect to keep gasoline in a storage area, be sure it is secured so it is really safe and unlikely to be upset, breached, or ignited by any nuclear thermal pulse or blast effects. An electric generator might be very useful in the post attack environment, but only if you have the fuel to run it. My key point is that you need to have ready access to enough fuel so you don't have to delay to find some gas in a high radiation or otherwise dangerous environment.

As with weapons, the issue of ammunition stocks is up to you. I personally doubt if there is going to be a lot of game running around in any contaminated areas, unless you consider rats in that category ;-). For $100+ invested in rice, wheat, salt, peas, corn, flour, and the like, you can meet your caloric needs for a year. So why bother with the doubtful trapper/hunter approach? Having a year or more stock of food also means you don't have to go out and interact with possibly unfriendly folks too. Don't forget that many endemic diseases such as cholera, tuberculosis, and even plague could infect large numbers of victims whose immune systems are weakened by radiation sickness and lack of food and medical care.

Besides the usual OCD (Office of Civil Defense) food, water, blankets, tools, and so on shelter stocks, you should also get creative. There won't be many Fuller Brush salespersons going door to door, so buy those fallout dusting tools now. Hoses, buckets, brushes, rubber boots and rubberized rainwear will also be in demand, especially during the initial cleanup period. Plastic sheeting for windows, small nails, and related items may be very helpful to repair windows after post-attack sheet window glass stocks are exhausted. Clothing may be hard to find, so spare or out of fashion items that fit may suddenly take on great value. Consider storing old shoes and boots too. Needles and clothing repair items like scissors and thread and buttons may be hard to find too. A trip around hardware, grocery, and thrift stores with post-attack needs and uses in mind could turn up other must-stock items.

Some sources suggest that personal grooming items will also be quickly snapped up. Frequent washings will be needed to remove fallout contamination, so soap and cleaning supplies will be quickly used up. Dentists will be hard to find, so careful flossing and spare toothbrushes and toothpaste may be a wise investment too. Assuming you are able to use rechargeable batteries for portable radios and radiation instrument batteries, how will you recharge them? A solar powered panel might be the best answer in some areas after battery stocks become depleted.

Gasoline is a necessary item for travel or generating power using a car to recharge your shelter lights battery. Some inverters will convert 12 volts DC power to a rough (square wave) 115 volts AC power at up to 250 watts or so (see Radio Shack, around $75-125US). A smaller efficient and portable generator would be ideal, but expensive. You can build a small generator out of a small gasoline powered engine (i.e., lawnmower engine) and various car engine parts in the post attack period. Sample designs and wiring diagrams are in older copies of the ARRL Radio Amateur Handbooks.

Incidentally, there will probably be lots of gasoline around after a nuclear attack, people just won't be able to get to it. The problem is that subsurface gasoline tanks at most service stations require electrical power to pump the gasoline up out of the ground. No electrical power means no gasoline pumping, but there could be thousands of gallons in the tanks. A sufficiently large inverter or small trunk mounted AC generator could provide the AC power needed to pump all the gasoline you want.

Lacking power, you might be able to using existing piping to siphon gas out, or dig down and breach such gasoline storage tanks (Carefully!). More simply, a standard siphon hand pump and gas containers could be used to siphon off the unused gasoline from crashed or abandoned vehicles in the post-attack period. Recall that EMP may disable vehicle electronics including fuel injector modules over a large area, so there will be a plethora of non-working but gas-filled cars and trucks around.

These ARRL radio amateur handbooks cover a lot of radio theory that might also be useful to know in setting up antennas and a shortwave monitoring station. During a tense world crisis situation, you will find a remarkably different view of events from listening to foreign news services such as the BBC and other national services than is available locally (i.e., in the rather homogenized U.S. TV news services). So a shortwave listening station might be a useful resource during the pre-attack period, to highlight mounting tensions and threats and raise your own preparation levels.

The Internet also supplies lots of non-USA mass medium information outlets which could also provide an alternative view. A political crisis or coup in Russia or China might be a good time to take those accumulated vacation days at someplace outside logical target areas. Those SS-20 missiles are all still ready to go, and nobody seems to be working on any Russian Year 2000 fixes either.

To return to the issue of generating power, there are a number of books that describe how to build farm sized power generators from water-wheels in dams on brooks or streams to classic windmill setups. A more useful approach in some post-attack situations will be the use of alcohol (not gasohol) based fuel from fermentation. You will probably want to have a still anyway, now you can use it to generate power. Many small engines and even car engines can be modified to run from alcohol fuels. In some cases, it just takes adjusting the engine and drilling some larger openings to the carburetor (circa 40% larger). Again, a variety of books cover this conversion approach. You might not want to make these modifications today, but it might be useful to get this information and the necessary drill bits (and spares) and tools to make it work.

Speaking of skills and stills, you might want to take advantage of the liberal U.S. laws allowing you to brew your own beer and make your own wine. You can buy all the supplies needed for a still, without setting one up. During the colonization of the U.S. Midwest, hard alcohol was the means of exporting the bulky Midwestern crops in a compact and high value form - moonshine! Processes involving filtering and distilling are likely to reduce contamination as well, and might revive this old American tradition for an unforeseen new set of reasons. Similarly, Brazilian farmers reacted to the oil price shocks by switching to alcohol based farm produced fuels rather than gasoline.

Similarly, you can identify food preservation as a major future problem in a post-attack environment. Some items like a used pressure cooker and bell jars can be purchased inexpensively from thrift stores. Rubber rings are easy to buy today. Other supplies like sugar, salt, and other preservatives can also be secured and added to shelter stocks.

In short, look for ways to stock up or retain items that will be useful in a post-attack world. The *Alpha Strategy* approach can justify some of these items as a money-saving commodities investment. Other items can be bought second-hand, at garage sales, and simply put away with the hope they will never be needed. In some cases you can just stock up by buying extra items rather than running to the store for every little item you need.

In short, you can probably justify most of your shelter stocking and preparation for dual use needs, and save money doing so using Pugsley's Alpha Strategy approach. The main single use items include medical resources and specialty items such as radiation monitoring instruments. Starting with the radiation instruments, the good news is that the costs are relatively low. For under $100, you can probably buy a couple of radiation survey meters and a geiger counter and still have funds for batteries. You will probably save this much money in just the first month using the Alpha Strategy. You may feel prepared with standard first aid courses and a well stocked medical chest, at least until you have read some of these boating first aid manuals. Lots of the recommended items have unlimited shelf life, such as bandages, and so are a one shot expense. Whether you elect to go whole-hog and get the full set depends on your interests and budget.

Now you can also speculate about what items would be most in demand in a post-attack environment. For example, salt, pepper, and spices might again be worth their weight in gold as during the middle ages, due to the breakup in transportation and refrigeration. Fragile lighting bulbs for incandescent or fluorescent fixtures might be rare too. Plastic might have to replace window glass? A spare geiger counter might be worth more than a house? A zeolite water purification cartridge setup might be worth more than a car?
Another area to consider is picking up knowledge and skills which might be useful in the post-attack environment. For example, you might take one or more of the Red Cross style first aid or CPR courses. They also have courses on fire-fighting and rescue. A ham radio class might open up a fun hobby, as well as aid in setting up radios for monitoring and communication. How about an engine repair course, in case you get stranded on the road? Don't forget to stock up with the fan belts, tools, and other items you might need in an emergency - as during an exit from the contaminated area. A cooking class or food canning course offered by a local college or adult education source could be useful too. Even a gardening class or two could be fun, and would open up a profitable and very useful post-attack environment skill.

Finally, don't forget to get more of what you are getting now - knowledge about the post-attack environment and how to survive in it. Hopefully, you will never have to face any of the nuclear attack scenarios listed below. But you might want to add some of the major books on the subject to your shelter library. The Effects of Nuclear Weapons is one such classic. There are numerous civil defense publications, some now posted on the WWW, which would also be useful. Pages such as this one might be handy references too. In short, you should also stock up with books and knowledge that you can tap in the post-attack environment to help ease the return to a normal life existence.

Scenarios

Single 10kt Terrorist Burst
This scenario assumes that a terrorist gets a small 10 kiloton fission device, similar in yield to the ones used by the U.S. on Hiroshima and Nagasaki. The optimum site for such a single device to do the maximum damage has been suggested to be St. Louis, Missouri. These studies noted that such a hit would likely disrupt or destroy the greater U.S. economy. The reason is that St. Louis is the centrally located city to which checks are mailed daily to reconcile U.S. bank transfers and exchanges. So even a small weapon would destroy this facility, and these unique and irreplaceable machines with it. In short order, the U.S. economy crashes as it is impossible to process the required volume of checks by hand.

The smaller device size may minimize the area contaminated and enhance the ability of folks to exit this area speedily for other areas. Shelter might or would still be useful, and care about ingesting or inhaling fallout particles in the contaminated area should be a major long-term health concern.

100kt to 1,000 kt Terrorist Device
An enhanced fission or fusion device raises all the problems of taking extended shelter. The larger range of thermal, EMP, and blast effects is clearly a bigger problem the larger the device gets. The contaminated area would be much greater. If only a single device were used, then much of the U.S. would be uncontaminated. Again, the optimal strategy might be taking shelter for 2 to 4 weeks or more as desired or possible, then a quick exit to uncontaminated areas.

Low Numbers of Weapons in the 100kt to 1,000kt Range
A single MIRVed missile can represent up to a half-dozen or more warheads (60kt up). If targeted against different cities or targets, such an attack could cause millions of immediate and short-term deaths (6 to 15 million or more). Millions more would die of the long-term side effects, chiefly from cancers and other radio-isotope uptake related diseases. Millions would also be burnt and injured. Local or national government could be destroyed or disrupted (e.g., Washington DC a target city). Fires might range over huge areas, including highly polluted plumes from burning chemical factories and city areas as well as forests.

While uncontaminated areas might exist, getting there in the ensuing chaos could be quite hazardous. Staying in a shelter area for a prolonged time might be a strategy for avoiding threats from individuals or ad hoc groups. I suspect many local or state governments will employ extreme means to draft a workforce in an effort to restart a dead economy.

The optimal attack strategy for a single MIRVed missile is to target all of the major refinery complexes in the U.S. (7 to 10). This attack pattern would again destroy the U.S. economy at one of its weakest point, our dependence on large fossil fuel resources. Our agriculture is heavily dependent on energy resources, as is our industry and our commerce. Even if the number of dead killed directly is relatively less in such an attack, the long-term disruption could kill many more millions from famine and economic disruption (e.g., pharmaceuticals depend on petrochemicals).

SLBM Submarine Full Missile Launch

What if a coup faction gains control of a nuclear missile launching submarine? A single submarine can launch not just handfuls but dozens and hundreds of warheads at U.S. targets. Such an attack pattern is suggested by the header animated GIF courtesy of Greg Walker. The entire U.S. would likely be involved, leaving few if any uncontaminated areas. Assuming a city based target list is used (versus say a counter-force strike), up to half the U.S. population would be dead or dying in the first few weeks.

Such an attack pattern is obviously unprecedented, so we may be in for some surprises. Carl Sagan and colleagues discovered and popularized the issues of *Nuclear Winter* based on studies of MARS and other sources. These studies suggest that enough dust and smoke could be injected into the upper atmosphere that the earth's albedo would change. More sunlight would be reflected off the dust, and the earth would chill. Studies of large volcanic eruptions has confirmed some of these model predictions at the small scale end. The possibility exists that weather in the Northern Hemisphere could be disrupted for 5 months or more, by some estimates up to two years plus. This disruption would involve unseasonably cold weather during the summer crop growing season, as just one prediction, and terribly cold winters.

All-out Exchange

Unfortunately, there are tens of thousands of nuclear weapons in various hands around the globe. An all-out exchange could involve tens of thousands or more of these devices. Systems fail, and such an exchange could conceivably be started by accident and an enraged response. Thousands of formerly Soviet warheads are still atop missiles with U.S. targets, according to many reports. Computer errors as mundane as the Year-2000 problem might accidentally trigger such an exchange in many scenarios.

An all-out exchange might be precipitated by a clever terrorist or adverse government with only one or a handful of nuclear weapons. The scenario here involves waiting for or precipitating a confrontation between the U.S. and a nuclear armed adversary (e.g., Russia, China). Wait for a time of maximum uncertainty and instability. Then the terrorist group or government detonates the device in Washington D.C. and other sites calculated to appear as a close-in submarine launched attack. The U.S. would presumably respond with an all-out exchange in the hopes of destroying counter force targets before they could also launch. This U.S. surprise attack in turn precipitates an equally devastating counter-attack against the U.S.

The interesting feature of this scenario is that the massive attack upon and destruction of the U.S. could be a side-effect of the intended and desired attack against their main threat and larger nuclear armed neighbor such as Russia or China. The result would effectively remove the neighboring state as a major power, and the U.S. as the world's superpower.

Summary

Naturally, we have only looked at a few possible scenarios here out of thousands. Different scenarios have different implications for post-attack activities. A single or handful of nuclear weapons strike might suggest leaving for an uncontaminated area and possible survival of the U.S. Larger numbers of weapons make uncontaminated areas unlikely and harder to find, and almost ensure the disruption and destruction of the U.S. economically and physically.

One point remains to be re-emphasized concerning the unknown but potentially disruptive environmental effects of nuclear warfare. If the nuclear winter scenario comes to pass, then food stocks will be a critical issue. Instead of 2 weeks worth of food, you might need 2 years worth of food!! In such a circumstance, having stocked up on additional cheap bulk grains such as rice or wheat could provide the means for survival.

Nuclear EMP

Having cited nuclear EMP as a cause for destroying electronic systems, we can also suggest a scenario in which one or more nuclear weapons are used to create a huge nuclear EMP effect. Most of the U.S. could be crippled by a single nuclear burst of sufficient size in low orbit (circa 100 miles) over the near center of the mainland U.S. landmass. Usually, several devices are used over each coast in such scenarios to guarantee maximum effect over the dense coastal population centers. A certain number of people would receive fatal shocks from such nuclear EMP, and some pacemaker and other electronic medical device hookups would fail with fatal results. Most fatalities would be caused by planes falling out of the sky or other vehicle crashes and hospital operating room failures. But overall casualties would be very light for a nuclear war, in human terms.

However, the electronic systems of modern commerce (and warfare) would be largely knocked out by the nuclear EMP pulse. This N-EMP pulse is very similar to lightning in its effects on electronics, but has a much shorter rise time (circa nanoseconds) and higher peak energy level. The result is a devastating pulse or zap of electricity that readily destroys sensitive semiconductor junctions in most electronic devices. Any long conductor (over a few inches) such as antennas, power cords, keyboard cables, modem lines, telephone lines, and the like will help couple enough energy into the system to destroy it.

Nuclear EMP is another example of an unexpected side effect of nuclear weapons, like nuclear winter, which wasn't discovered until larger weapons and transistorized equipment were used. Earlier tests had used tube radio equipment, which is much less sensitive to the destructive effects of nuclear EMP (because they lack silicon junctions and have large energy absorbing plates and cathodes).

In civil defense and military applications, special high speed gas diodes are used to protect against nuclear EMP. Some of today's high speed MOV and clamping diodes may be fast enough to protect or bypass some or all of the nuclear EMP where relatively little energy is coupled into the circuit. Examples would include VHF portable radios with short antennas, powered by batteries, such as portable police radios and portable FM/AM stereos using speakers (not headphones with wires).

What can you do to minimize the destruction from such an EMP blast on electronic items in your shelter? The simplest starting place is to unplug critical items from power cords and wires when not needed. Actually, this is another good idea in general, as lighting strikes against a house or nearby telephone pole can use these same wires to get into and destroy your electronic items. Fortunately, you can buy very cheap battery powered radios with a variety of shortwave, time clock, weather, police and fire, and TV audio bands for under $30US at Radio Shack and similar stores.

You can also make a Faraday shield cage. A Faraday shield is a continuous metallic conducting cage around your electronics items which prevents nuclear EMP or lightning like pulses from getting conducted or coupled into the inside of the cage. The cage can be from highly conductive single sheets of copper or even fine copper screening. Even a homemade Faraday cage would probably protect electronic items enclosed inside which would otherwise be destroyed in many nuclear EMP scenarios. This effect is why it is best to stay inside a car if caught out on the road in a lightning storm. If lightning hits, it will flow around you and not enter the inside of the car significantly, thanks to the Faraday shielding effect of the metallic car body.

As an aside, the nuclear EMP issue is why some people buy and stock both transistorized and tube based electronics gear in their shelter. Tube based electronics would be much more likely to survive a nuclear EMP event, and spare tubes (hint) would be easily swapped out quickly. The smaller transistorized gear is placed within an enclosed metal box, with all wiring disconnected, and carefully sealed up. Spare GM counters, dosimeter chargers, radios, and other electronics are stored as backups so if the ones in the shelter get destroyed by EMP, they can be unpacked and used later. Many tube based survey meters, GM counters, and earlier instruments require heavy tube filament batteries, but provide an extra degree of EMP protection over their later solid state brethren.

Besides the direct, prompt nuclear EMP, there is also a lesser known secondary effect that has longer duration. This effect is known as magnetohydrodynamics EMP, and is related to the effects of moving charges and fields in longer conductors. In this case, we are talking about even buried cabling and wiring. While fiber optics is impervious to direct EMP effects, it is jacketed and strung with metal cabling to enable pulling it off the reels and into conduits and underground piping. Depending on whether single mode or multimode fiber optic cabling is used, electronic repeaters are needed every ten to fifty miles or so to regenerate the pulses for the next cable segment. Some people believe that these fiber optic systems will operate through EMP events. Unless all the elements of these systems have been designed and protected, particularly the electronics and their integral power sources, this belief is probably wrong. In other words, these networks will fail when their electronics fail.

If you take this localized nuclear EMP effect, and multiply by all the electronics and solid state equipment like computers and faxes and phones and television studios in the nation, you can see why losing all electronics could be a disaster. Electronic commerce would be ended instantly. Financial markets could not even open to register their own crashes. Banks couldn't calculate balances, let alone pay bills electronically. In short, the U.S. economy would likely be destroyed, along with the command and control infrastructure needed to wage effective warfare and maintain government operations. So a nuclear EMP component at the start or during the early part of any nuclear exchange might part of other scenarios, as well as a stand-alone attack option.

Reactor Accidents
As scary as a thermonuclear bomb might be, it has only a rather limited amount of fissionable materials which form the bulk of the radioactive contamination. Instead of kilograms of such material, the average power reactor has tons of radioactive wastes mixed in with its fissionable fuel (uranium or plutonium usually). A large reactor might have enough fissionable material to represent 10, 20, 50, or more critical masses. Even worse, most of the short lived isotopes have decayed. Much of what is left is much longer lived than the average for a nuclear explosion's radioactive debris. In other words, none of the decay rules for a nuclear burst (based on t ^ -1.2 curves) will probably hold for a reactor incident. The fallout would likely be very slow to decay and represent a major long term and continuing hazard.

In most reactors, an accident or terrorist explosion would release lots of radioactivity in the form of radioactive iodine, chiefly in a sublimated or gaseous form. This radio-iodine gas would spread quickly in the air, and be taken up readily from the air into the food chain. One possible concentrated source would be milk from cows raised in exposed pastures. You could simply breathe in air with gaseous radio-iodine, and receive an internal dose that way. By contrast, fallout is not a gas but a dust sized particle, and can be kept out of shelters and homes.

The threat from radio-iodine uptake is a major reason to buy and use iodine tablets prior to and during a reactor accident or other nuclear incident scenario. This non-radioactive iodine will help prevent the body from taking up much of the radioactive form, preventing thyroid cancers and other medical problems. Since iodine concentrates in the thyroid gland, and is most actively taken up in growing children, this threat from radio-iodine is especially dangerous to children. Similarly, we would recommend calcium tablets (with vitamin D or other uptake enhancers) to help reduce the uptake of radioactive strontium and cesium, which are often found in fallout or reactor contamination.

Unfortunately, we have already seen some of the realities from such a reactor explosion via the Chernobyl reactor accident. Large areas have been contaminated and are unsafe to live in or even drive through. Thousands have been exposed to levels of radiation that suggests a destiny ending in a death due to cancers contracted in this incident. While only a handful died directly of radiation at or near the reactor, the areas impacted reached a global scale, particularly nearby European neighbors. Produce and milk had to be destroyed due to contamination.

A terrorist who explodes a smaller nuclear device in a reactor might not get a large sympathetic fissioning of the reactor components, although some might be possible, depending on distance and neutron flux levels. But it is likely that the containment domes (if any) would be breached and a much higher level of contamination would be dispersed. Moreover, unlike the usual nuclear burst scenarios, this approach would yield a much higher level of contamination and much slower drop in radiation levels with time.
Unfortunately, a nuclear terrorist really doesn't even need a bomb. Literally thousands of fuel rods from power and military reactors are sitting around in ponds of cooling water, waiting to be recycled. Naturally, they aren't anywhere near as well guarded as nuclear weapons. Remember that there may be a lot of plutonium in some of these fuel rod designs, as well as induced in uranium fuel from neutron capture. The fuel rod will also have lots of longer lived radioactive waste products in it, equal to not just one but perhaps a dozen or more typical nuclear bombs. In short, a terrorist could simply steal a nuclear fuel rod, pop it in acids to turn it into a highly radioactive slurry, and convert it into dust or dilute it into a highly radioactive fluid. Now simply arrange for it to be used to contaminate the desired target city. A fire fighting or crop dusting plane would be very effective, but a mosquito spraying truck or other approach would work well.

The result would be thousands of deaths in the short-term from ingested and inhaled radioactive particles causing instant cancers and radiation sores in the skin, intestines, and lungs. Many others would get fatal radiation doses before authorities would realize that the city had been contaminated. Contamination would be widely spread as radioactive dust transported by travel to the suburbs and more distant communities. Such a city site would be highly contaminated at a level that it would have to largely be abandoned or destroyed. Even the dirt would have to be buried as radioactive waste at special sites.

One of the lessons from Chernobyl is that the authorities are hesitant to tell unpleasant truths to people, even if they are being poisoned and killed by withholding such information. Moreover, even the Soviet Union did not have an active and reliable radiation monitoring system in place just outside the borders of its own nuclear plants, or even in major cities such as Kiev. The post-cold war situation in the U.S. is hopefully much better, as far as nuclear monitoring stations goes. But it is not certain that such information could or would get released to the public promptly. If you live near any U.S. nuclear plant, you probably can research up a listing of events in which moderate amounts of radioactivity were released due to various accidents. Most of these incidents are also characterized by a lack of public disclosure or forewarning. While they are spin doctoring, you will need doctoring. ;-)

In short, you may have to setup your own early warning system. Relatively cheap ($100 - $150 US) nuclear radiation detectors (gamma/beta) exist which have a squelch mode of operation. As long as the level is below what you have set, no alarm goes off. But if your preset level is exceeded, the alarm goes off. Simple. You set the alarm level just above your usual background radiation and then add a little bit. If an accident or radioactive spill happens on a nearby highway, or if radiation is detected, the device sounds off and wakes you up to get into shelter. These detectors can run a long time off of rechargeable batteries, or off of your power line. Some units automatically switch to batteries if on line power is lost, but beep to warn you of this problem. With this setup, you are not dependent on outside warnings or warning systems that may not even exist anymore in your area.

Salt Bombs
Salt bombs are nuclear bombs that have been salted or surrounded with a jacket of selected materials. The most well known material is cobalt, as in the infamous *cobalt bombs* of the Dr. Strangelove doomsday bombs. The idea is simply to make use of neutrons released by the nuclear explosion. Usually, some large fraction of neutrons are lost or wasted, and interact with random atoms in the surroundings. If the bomb is burst in the air, the amount of material is low and induced radioactivity low too. If the bomb is at ground level, much more material is subject to getting hit by neutrons and turned into radioactive isotopes.
The bomb itself can be made of relatively minimal amounts of fissionable materials, be built of materials with low induced radioactivity potential, and get most of its energy from fusion rather than dirty fission processes. Such weapons are called "clean" nuclear weapons, as they produce relatively little fallout or radioactivity. By contrast, you can also build a "dirty" bomb which gets a lot of its energy from fission, and also has a layer of cobalt or other material that can be turned into a deadly radioactive gamma emitter. The result is a much higher level of gamma radiation than expected near the bomb site. Radio-cobalt has a very penetrating and powerful gamma ray decay, and takes not days or weeks but decades to reduce significantly in radioactivity.

So why aren't cobalt bombs more popular with smaller nuclear states who want the most bang, so to speak, for the buck? The problem with cobalt-60 is that it gets into the stratosphere and ultimately some of it may end up in the enemy country's own biosphere. A better approach is to select a shorter-lived but very intense gamma emitting isotope. For a nuclear terrorist with a limited budget, plain old salt or sodium chloride may suffice. Both sodium and chlorine can be rendered radioactive, and are cheap and easy to procure in even large quantities, unlike say, a ton of cobalt dust. The resulting gamma radioactivity is very intense, and greatly expands the areas exposed to thousands and even tens of thousands of RADS. Only those in excellent shelters will survive such an attack. Yet the half-life is short enough that it won't come out of the stratosphere to poison the attacking country (in any large quantity).

A related dirty trick is to pick the right sequence and timing for the multiple bombs usually targeted at each target. To ensure against any major target or city surviving unscathed, a large number of weapons are targeted at each site. These weapons are on multiple missiles, so failure of one won't mean all its targets escape destruction. They are timed to arrive at different times, so explosion of one won't prevent the explosion of its fraternity brothers (hence, weapons fratricide - pun intended). Moreover, some weapons would be targeted as ground-bursts, in order to maximally destroy the localized target area and generate fallout. The backup weapon would usually be targeted as an air-burst, in order to get maximum thermal pulse damage to exposed humans and induce fires over as large an area as possible.

The trick is to combine the two explosions in a precise sequence, so the ground burst goes off, then the air burst above it. The air burst blast wave interacts with the rising fireball of the ground burst. The result is that much less radioactive fallout is blown into the stratosphere, so it doesn't eventually land on the attacking country or its allies. But a lot more of the fallout is blown back down and onto the target site and its surroundings. Blast wind speeds are hundreds of miles an hour near the starting point, rather than the ten or fifteen miles an hour of high altitude winds with a normal nuclear cloud. The largest amount of radiation is actually released in the first few seconds and minutes of the explosion, but high in the radioactive cloud away from the human targets. This trick pushes the fallout down onto the target much sooner, and concentrates it in a smaller area around the city or target site. The result is to greatly increase the amount of radioactive contamination of the target site. Even people in excellent shelters near the target site would possibly get a lethal dose due to this early and highly radioactive fallout dosages.

Summary
We have just touched the surface of some possible or even improbable attack scenarios here. But as you can see, there are lots of ways for an attacker to maximize the amount of bang, burns, and radiation they get out of their attacks. Even the usual nuclear terrorist scenarios where a few weapons are available or used could be devastating to the U.S. as an economy and society. Hopefully, some of the ideas in this article will help ensure your own survival if the worst does happen.

Flaws in Government Scenarios

Government studies that are released to the public usually fail to provide realistic scenarios and advice. As one example, during the early 1970s we were still being advised that the lack of ham radio (RACES) sets in many shelters was not a problem. We could simply pick up the telephone and call these remote shelters, using the radio to contact higher State and Federal government authorities. This recommendation overlooked the fact that our telephone central offices are almost invariably located at or near the center of the urban areas they serve, if only to save on wire run distances. Moreover, nuclear weapons have a tendency to knock down poles carrying telephone wires. EMP was not even considered in most of these studies, despite the widespread use of transistorized radio sets. In short, a major requirement was essentially unaddressed because there was no way to come up with a workable solution. We had to pretend that we would just pick up the phone and call around.

A major study was released to describe how the post-attack situation would look, based on various civil defense estimates. A small West Virginia town was chosen for the scenario. Only distant places were hit, so there were no direct effects from blast or thermal pulse. At first, there were hardly any changes. Gradually, medicines dried up, with diabetics and others on medication being the first to go. Advanced medical care from the city was no longer an option, with the city gone.

An influx of burned and injured folks put a strain on the system to feed and care for them, and these were the lucky survivors of the holocaust and radiation effects. Refugees had to be housed in other people's homes (a piece of current civil defense doctrine). Many items quickly ran out from stores. Fuel was unobtainable. Money could not be used to buy things because people wouldn't sell, not knowing when they could buy a replacement.

Food became scarcer. The attack's timing meant a harvest was lost. By means not explained, a delivery of food from distant Michigan grain storage silos somehow managed to reach this small town just in time to prevent famine and end the scenario on a positive note. The problems of transport over such distances, with most roads going through city centers that no longer existed, were brushed aside. Fuel and security (theft en route) issues were also minimized. Today, this rosy scenario is not such an issue, since our government has cut out these food and grain storage facilities as part of the budget balancing measures. Our national food-stocks are relatively much lower today than in the past, and we are living from harvest to harvest with minimal reserves.

What government preparations have been made are at two levels. For the top of the civilian governmental structure, we have an effective and redundant system of shelter sites that are well stocked (and armed). For the rest of us, we have lots of paperwork and plans. I cited the IRS having 50 million forms for requesting delays to pay taxes due to nuclear war preprinted and stored (mostly in cities). The post office has similar piles of pre-printed change of address or notification of death forms in storage. But paperwork isn't going to be very helpful in most large scale nuclear attack scenarios.

The FEMA plans for a nuclear attack are to assume that we have sufficient warning to be able to mobilize our population out of the target areas into the surrounding hinterlands. Think about that. Even the pretense of identifying city and suburban shelters and stocking them with stale food crackers has been abandoned. Similarly, stocks of radiation monitoring instruments and other post-attack necessities have been surplus or destroyed.

In the event of a successful out-migration from the target area, the problem that predominates is the difficulty of housing and feeding all these people whether there is an attack or not. Recall that the hinterlands don't have enough food stocks to feed the additional population of a city for long. The trucks carrying food into the city for daily use can't be effectively rerouted to where they are needed in the dispersed communities. So you don't or can't disperse unless you are sure an attack is likely, and by then, an attack is probably in progress. In the meantime, communities are required to draw up plans on how they will house and feed large numbers of refugees from the city targets. Nearly everyone agrees these plans are useless, but the paperwork is required federal government busy-work.
The major problem for post-attack planners is how to revive and restart the U.S. economy, given that so many of the essential resources are likely to be destroyed in a nuclear war. The most important resource is trained people, such as air traffic controllers and medical doctors, most of whom live in lethal target areas. Without these required skills and people, the economy can't be revived, which is the critical issue our planners couldn't face.

Most Americans don't know that a series of laws are already voted and enacted and in place to give the government complete control of all the country's resources and its people in the event of a crisis as designated by the President. These laws are draconian in the extreme, providing absolute power to the surviving national command authority. The goal of these laws is to provide the legal basis for essentially subjugating the rights and lives of the surviving people and everybody's property to the needs and interests of the government, as they see fit. Any and all property can be seized, laws and personal rights can be arbitrarily set aside, and people can be drafted and put to whatever purpose suits the government.
You may object to your government's plans to draft you and send you to die in a radiation zone trying to reclaim some machinery or decontaminate a piece of highway. Personally, I doubt that the government could maintain any semblance of authority under these expected conditions, let alone enforce its edicts. However, I could be wrong. This threat from an out of control government seeking total control is yet another reason to be able to stay in shelter long enough and remotely enough that you can avoid these death-throws.

Marauding Bandits Scenario
This scenario probably arose out of movies showing motorcycle gangs taking over remote California towns. The idea is that bad people will somehow escape Armageddon unscathed, and come out of the cities raping and pillaging their way across middle America. Authority will be gone, and anyone with a gun is in charge.
Howard Ruff has suggested a flaw in this argument. What if you take the number of people in any nearby city, deduct for the number of expected deaths, and then distribute them around the surrounding countryside? You get a fractional number of banditos per square mile, which doesn't seem like much of a threat.

The problem with Mr. Ruff's analysis is that these banditos can be highly mobile, at least until the gas runs out. Like the Mongol hordes, they can cover a lot of miles in a day, ruining everybody's day whom they run across. You can assume they have superior firepower to the average non-gun toting citizen, and a willingness to use it with police authority gone. The main defense would be staying out of their way in shelters, rather than having to compete with them by foraging for food or fuel.

Personally, I think this scenario is unlikely as a long-term threat. Gasoline will run out quickly, as will readily raided food stores. Radiation will weaken and kill off anyone out and about, as will rampant diseases. Enough people have guns in the U.S. that being a bandito is likely to be a hazardous occupation. I doubt there would be enough food surpluses to permit large gangs to stay together as stocks get used up over time.

British Scenario Errors
The British made one of the biggest scenario errors possible. They decided to make a film to explain to folks what a nuclear war would be like. The good news from the British viewpoint was that we Yanks got the major part of the Soviet nuclear attack on our heads. The bad news was that a few rather large 10 megaton bombs exploded on her Majesty's cities such as Liverpool.
Again, a warning was assumed, and people moved in forcibly by decree into unwilling people's houses and property. Food had to be shared with these refugees from the city. Essential workers had to stay in the city to keep things like the economy running, until they got vaporized, that is.

The results of the flash and blast were realistically described, leaving little doubt in most of the viewing British audience that they would be literally blackened toast in such an event. Various diseases immediately broke out because of poor sanitation, lack of doctors and medicines, and poor medical care. Hunger was rampant due to lack of stored supplies. Some rather gruesome scenes showed mass burials of hundreds of corpses by bulldozers and burning, with lack of lime to control disease and the smell being another in a long list of inadequate supplies.

In short, the movie depiction was sufficiently accurate that it was banned from being shown so as not to excite the voting public. ;-) You can, however, buy it in the U.S.

Soviet Scenario Errors
As bad as our scenario errors often were, the Soviets had an even worse time of it. Due to rigid secrecy rules enforced by forced labor and death penalties, the civil defense apparatus was forced to rely on a Soviet reprint based entirely on the classic U.S. Effects of Nuclear Weapons (FM-50). They couldn't be exiled for revealing Soviet secrets in an openly published American book, after all.
The problem here was that the translators didn't understand nuclear weapons physics. As an example, a critical table was translated by reproducing the numbers, but translating the word miles into kilometers and so on. The result was to give the impression that American nuclear weapons were considerably less powerful than they really were (circa 36% based on area destroyed under this mistranslation).
Later, the same Russian civil defense manual was re-translated back into English from the Russian text. The U.S. translators caught the mistranslation, and footnoted it to highlight these errors. Naturally, the Soviet defense groups knew that the American weapons were designed to completely destroy the relatively small and compact Soviet cities.
But it served Soviet war doctrine purposes to have their own civil defense people believe rather optimistically that U.S. nuclear weapons were much less damaging than they really were. The Soviet citizens were to believe that major parts of their cities would survive our attacks, based on these mis-translated charts.

My Own Scenarios
My own scenarios are likely to be as inaccurate as anybody else's scenarios, given that we haven't ever experienced a real nuclear war. My guess is that people will be surprised and shocked by how rapidly and thoroughly things fall apart. Police who have been in riots in places like Miami or Watts might be exceptions to this view. They already know how thin the line is between civilization and mob rule. The rest of us may soon find out after the bombs go off.
I believe that the biggest characteristic of the post-attack scene will be APATHY. People won't care; their families will be dead, jobs will be gone, and reasons for living uncertain. This psychological condition is common to such a traumatic loss situation. Some will feel guilty they survived, while others did not. Lack of food and radiation sickness and medical stresses will probably extend the grip of apathy to most of the population. Most people who try to restore anything will fail, mainly due to lack of essential but unavailable resources or human skill sets.

My scenarios all assume that the U.S. economy collapses, adding insult to injury with disjointed and ineffective productive efforts. A plant will be reclaimed at the cost of many lives, only to be abandoned due to the lack of inputs and knowledgeable people to make it work. Farmers will plant and grow food that will have to be discarded because of high levels of contamination. If the food is good, they won't have the means to get it to market. Soviet agriculture often grew plenty of food to feed the people, it just couldn't get it out of the fields and into enough trains and silos to reach the people who needed it.

One of the side effects of the black death in Europe was that so many people died that the survivors became relatively more wealthy. Assuming a single-submarine launch sized war, perhaps about half the U.S. population will be dead in a few months. We might have lots of cars, but no gas to run them. We could have lots of survivor's houses, but no glass or heating oil or water service to make them livable. Electronics galore, all of it needing EMP caused repairs. The real necessities like medicine and food would be scarcer. Most professions and jobs would be unneeded, providing no basis for earnings or wealth. Wealth might be a skill in demand readily traded for needed goods, or access to resources and services ranging from medical care and medicines to gasoline and fuels.

Some modelers suggest that external inputs from abroad would enable the U.S. to regain its economic feet in short order. I suspect that the collapse of the U.S. economy will lead to parallel collapses among other European and Asian countries. For one thing, these countries hold huge stocks of their wealth in the form of trillions of dollars and U.S. treasury securities, as well as U.S. corporate stocks or bonds. These dollar based paper assets will be understood to be uncollectible and worthless assets, leading to mass bankruptcies, following a large scale nuclear war against the U.S. Moreover, removing U.S. exports of agricultural produce would likely produce a worldwide famine, especially if a nuclear winter ensues.

So I see three tiers of deaths in my scenario - the original initial attack deaths, those who die in a few months due to radiation and disease, and a set who die when famine and lack of medical supplies becomes widespread before economic recovery. While a nuclear winter would really decimate the surviving population, a broad scale agricultural failure would have similar effects. These Malthusian mechanisms would reduce the U.S. population down to a simplified carrying capacity based on limited agricultural inputs (in energy, pesticides, fertilizer etc).

At these lower population densities, the limited agricultural input model could sustain the population, providing a basis for economic recovery. Economic production would resume with many simple tool base industries to make needed simple goods. Glass and metals might be recycled. Medicines could be imported using reclaimed wealth (precious metals and gems, perhaps art). And eventually an economy of sorts would be recovered in the U.S. and the rest of the world, following the U.S. economic collapse impacts being worked out.

If you remember nothing else, remember the Rule of 7 and 10:
For every 7x increase in time, the radiation dose rate will decline ten-fold (10x), viz:

Time	Dose Rate
1 hr	1000 rads/hr
7 hr	100 rads/hr
49 hr (2 days)	10 rads/hr
14 days (2 wk)	1 rad/hr
90 days (14 wk)	0.1 rad/hr

Why Immediate Shelter?
This 7/10 rule highlights the critical importance of seeking early shelter, as will inspection of the fallout dose rate table. The dose rate in rads/hr drops off greatly in just a few hours and days. You need to be in an effective shelter during that time to avoid a fatal radiation dose!

The nuclear fallout shelter model spreadsheet linked above calculates:

- fallout arrival time
- dose rate at various times (rads/hr)
- accumulated dose at various times (rads)
- effects of various shelters on accumulated dose

No spreadsheet can claim to model the exact effect of a given nuclear weapon explosion in the light of the many variables involved, including wind shear, rain, and weapons composition (fission/fusion ratio..) et. cet. But this model at least provides a generalized view of the downwind effects and the benefits of seeking early and effective shelter.

The model also documents the effectiveness of various materials and structures as a shelter. Effective shelter from fallout is literally dirt cheap! A basement can cut your exposure tenfold, while two feet of earth shielding can reduce your dosage to one percent of an unprotected person. We usually consider a shelter with 3 feet of earth shielding to be ideal. If you are farther from ground zero, you will have more time to locate and prepare an effective shelter. The materials below will help you select or make the best available shelter using materials available to you in an emergency.

What follows below is a sample printout from running the Excel shelter model and entering the required 4 input parameters shown in Steps #1 thru #4 below:

Fallout Shelter Model
Start by entering the 4 requested parameters

Step #1:	1000	weapon size (in kilotons 10kt to 10,000kt)
Step #2:	15	cloud wind speed (miles/hr, at 25,000ft, 15mph nominal, 8 to 45 mph)
Step #3:	100	shelter site distance downwind from target (miles, 15 to 300+ miles)
Step #4:	0.01	shelter protection factor (from none=1 to max=.0001)

R1= RADS at 1 hr and fallout arrival time calculated here

R1 (rads @1hr)	309	
Miles	100	
Arrival time (hrs)	6.333	
cloud radius=	5	miles
wind speed factor =	1	(15 mph=1.0 nominal)

Dose Rates (RADS/hr) and Accumulated Dose (RADS) shown against time; effects of shelter types on accumulated dose shown on right for specified shelter...

				Shelter	Frame House			Apartment Building				Concrete Block Bldg			Shelter above grade		Underground
Dose Rate	Time after burst		Accum Dose	Dose	surface	basement		Top Floors		Lower Floors		9 inch	12 inch	24 in walls	2 ft dirt	3 ft dirt	3 ft dirt
Rads/hr	(day)	(hours)	rads (rems)	0.01	0.8	0.1	0.6	0.8	0.9	0.3	0.6	0.15	0.075	0.014	0.05	0.014	0.003
0.0		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.0		2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.0		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.0		4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.0		5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.0		6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.6	.5day	12	128	1	102	13	77	102	115	38	77	19	10	2	6	2	0
9.6		18	201	2	161	20	121	161	181	60	121	30	15	3	10	3	1
6.8	1 day	24	250	2	200	25	150	200	225	75	150	37	19	3	12	3	1
4.2		36	313	3	251	31	188	251	282	94	188	47	23	4	16	4	1
3.0	2 day	48	355	4	284	36	213	284	320	107	213	53	27	5	18	5	1
1.3	4 day	96	447	4	358	45	268	358	403	134	268	67	34	6	22	6	1
0.7	7 day	168	513	5	410	51	308	410	462	154	308	77	38	7	26	7	2
0.3	2 wk	336	585	6	468	58	351	468	526	175	351	88	44	8	29	8	2
0.1	1 mo	720	653	7	522	65	392	522	588	196	392	98	49	9	33	9	2
0.1	2 mo	1440	706	7	565	71	424	565	636	212	424	106	53	10	35	10	2
0.0	6 mo	4320	777	8	622	78	466	622	700	233	466	117	58	11	39	11	2
0.0	1 yr	8760	816	8	652	82	489	652	734	245	489	122	61	11	41	11	2
0.0	2 yr	17520	848	8	678	85	509	678	763	254	509	127	64	12	42	12	3
0.0	50 yr	438000	952	10	761	95	571	761	857	286	571	143	71	13	48	13	3

Calculation Tables - cloud radius and R1 calculated here

Lookup Table:		Calculation Tables			
Cloud Radius		Selected Distance Unit Rate R1			
kilotons	miles	4.467	259.26	309	Rads
10	1	0.95	3000	2352.9	
100	2	1.8	1000	259.3	
1000	5	4.5	300	45.5	
2000	7	8.9	100	9.9	
5000	15	16	30	2.5	
10000	21	24	10	1.2	
100000	30	30	3	0.2	

Medical Effects Shown Here

	Vomiting	Therapy	Deaths	Hospitalization
<100 rems	none	unneeded	none	subclinical, mainly blood changes
100-200 rems	infrequent	effective	none	hospitalization generally not required
200 rems	common	effective	low	hospitalization recommended
300 rems	100%	effective	low	hospitalization recommended
400 rems	100%	guarded	moderate	hospitalization required
500 rems	100%	guarded	high	hospitalization required
600 rems	100%	palliative	90%	nearly hopeless
1000 rems	100%	palliative	100%	hopeless

Notes:	
1	contact surface burst assumed, t^ -1.2 decay characteristic (-0.9 to -2.0 range)
2	ignores surface geometry, wind shear effects, local rain, hot spots/cold spots
3	beyond 200 days, local weathering effects should reduce actual dose rate
4	model assumes nearly instantaneous deposition at fallout arrival time
	Actual deposition may take hours, largest error at closest distance to device
5	local weapons effects ignored - model is aimed at downwind sites outside direct effects
6	rule of 7/10s - for every 7 fold increase in time, you get a 10 fold drop in radiation rate
	example: 100 rads/hr at 7 hr, 10 rads/hr at 49 hrs (2 days), 1 rad/hr at 14 days
7	Shielding table provided to show effect of given shelter on reducing accumulated dose
8	Most important - nuclear weapons effects are highly variable, depending on wind etc.
	Above table can't reflect exact shelter location effects due to many variables involved
9	Beware: Error correction and catching of wrong, negative, out-of-range values is minimal
10	protection factor of shielding, 0.1 factor means only 1/10th doserate, 0.01 is 1/100th
11	cloud altitude wind speed ranges 8- 45mph, avg 15mph - this is wind speed at cloud ht.
12	Surface wind speeds are not relevant here, clouds moved by winds at 25-45,000+ feet
14	Lifetime recommended worker radiation accumulated dose is 5 rems
15	Rads are units of external (mostly gamma) radiation here, Rems are biological equiv.
	We are ignoring ingested or inhaled radiation particles and dosages in above analysis.

Summary:
This model is based on determining a one hour equiv. radiation rate R1@ 1 hr Rt radiation rate at time t is approx = R1 x t^ -1.2 (9.147.1 in No.50-3 reference). Using this equation, knowing estimated R1, we can derive Rt dose rate at later time t.
The accumulated dose is approx 5 x R1 x ((ta ^ -0.2) - (tb ^ -0.2)) (9.150.1 in No. 50-3) Again, using R1 and later time tb, from initial time ta we can get accumulated doses.
Ta here is calculated as time of initial fallout arrival, based on radius of mushroom cloud and wind speed, e.g., 80 miles away, given 5 mile cloud radius, and 15 mph wind (avg), we calculate Ta= (80miles - 5 mile cloud radius)/15 mph = 75 mi/15 mph = 5 hours.
R1 unit time @ 1 hr reference dose rate is calculated based on weapons yield and formulas provided in table 9.93 of No.50-3 for selected iso-contours - 3000 rads, etc.
A set of constants and formulae are used to derive width and ground zero width. A lookup table is used to select cloud radius based on weapons size from table above.
Calculation of R1@ 1hr for shelter at specified distance is based on linear table interpolation between standard isocontours (3000 rads, 1000rads..) in calculation area. Actual distribution likely higher nearer ground zero, below predicted farther away.

Note: above times are in months for suggested replacement or rotation, in other words, canned nuts would be replaced and used after 12 months or less, whereas hard candy should be cycled or replaced every 18 months or less.
Note: Up to 20 to 60 gallons of water may be in your hot water tank. Water may be in the kitchen in ice cubes, drinks, fruits, and so on. Water can be found in the flush tanks (not bowls) of home toilets. There is water in the pipes of your home. You may be advised to close your main water valve to your house to trap this water in your pipes (otherwise, it could run out back to the street and out a broken pipe). To access this water, open a faucet at the highest point of your home water system (top floor bathroom..). This will let air into the pipe, enabling you to drain water from a lower point in the system (e.g., basement water tank piping).

Note: If you must drink *suspicious* water - cloudy water from regular faucets, or muddy water from nearby streams or pond - purify first.

1) strain water through a paper towel or several thicknesses of clean cloth to remove dirt and fallout particles, if any. Or else let water settled in a container for 24 hours, letting solid particles sink to the bottom. A handful of clay in each gallon of water would help this settling process.

2) boil water for 3 to 5 minutes, or add a water purifying agent to it - either a) water purifying tables available at drug stores or b) two percent tincture of iodine or c) liquid chlorine household bleach, provided the label says it contains hypochlorite as its only active ingredient. Use 4 water-purifying tablets (size?), or 12 drops of tincture of iodine, or 8 drops of liquid chlorine bleach. If the water is cloudy, double these quantities!

Very little radioactive elements are expected to dissolve directly into the drinking water system; most will settle out in the first few days.
Note: Food should be rationed, as needed (except children and pregnant women), to ensure at least a two week shelter stay. Adults can get by on half normal food in shelter stay.

Note: Sanitation is important, as illnesses and vermin are a possible problem that sanitation can help you to avoid. Creosol or household bleach can be sprinkled into toilet to keep odors and germs down.