Easy Cellar

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Table of Contents

Introduction

Remember how happy everybody was when the Cold War ended and we could all stop worrying about nuclear war? The government sold off a lot of its fallout shelters, and many private citizens who'd been able to afford their own turned them into wine cellars or novelty man caves. Some people even just filled the entrance to their shelter with earth, landscaped over the top and forgot it was there.

I bet they're remembering where it is now.

Over the last two or three years the world suddenly seems to have gotten a lot more dangerous. We're not back to the bad old days of the Cold War yet, but we definitely seem to be heading in that direction. Unstable regimes are playing with nuclear weapons – Iran, Pakistan and North Korea. China is starting to get dangerously confident – and pushy – as its economy grows.

Maybe the biggest problem of all is Russia. Its military, which looked like collapsing for years, is growing again. It's getting more modern equipment, including a new generation of nuclear-tipped ICBMs, and it's rattling that rebuilt saber in the direction of Europe. Is the risk of nuclear war as high as it was in 1985? No – but it's rising again.

The problem is, the civil defense plans that existed during the Cold War were all cancelled years ago, and they weren't all that great anyway. Society has changed a lot since the 1980s and governments are more interested in welfare than civil defense, so don't expect to see much being done to protect the people from real enemies.

Basically, if you want to have any chance of surviving a nuclear war, you're on your own.

If you want to maximize your chances of getting through a nuclear attack you need to have some kind of shelter. Going down the basement, or sheltering somewhere else in your house, isn't going to help much unless you've prepared it to withstand heat, blast and radiation. If you do have some time to prepare you can create a lot more protection for yourself, but a proper shelter is still the best option.

Unfortunately, nuclear shelters cost a *lot*. Even a small, basic family-size one will cost tens of thousands of dollars, and not many of us can afford to spend that kind of money on something we hope we'll never have to use. I certainly can't. But, at the same time, I didn't want to leave my family defenseless if the worst does happen.

Instead of just crossing my fingers and praying the missiles never fly, I decided to see what I could build myself. Creating a survival bunker is something that's always interested me anyway, and with all the worrying stuff in the news these days I thought this was the perfect time to stop thinking about it and actually do it.

Obviously, I hoped my shelter would never be used for its ultimate purpose – but, even if it didn't, I thought it was still worth building one. Until the day comes when I need it to protect my family, a survival bunker makes a great root cellar.

Being mostly buried and surrounded by a thick layer of earth, the bunker stays at a pretty constant temperature no matter what the weather outside is going to be. That makes it ideal for storing your harvested vegetables. In fact, if you're trying to be self-sufficient, it's hard to get by without a good root cellar.

Any serious effort at growing your own food is going to leave you with a lot more produce than you can fit in a modern kitchen. That's why our ancestors, who grew almost all their own food, relied on

root cellars to keep their supplies safe and in good condition. Of course, our ancestors didn't have refrigeration, but a root cellar still makes sense – it doesn't need power to run, and will go on keeping your food supplies in good shape even if the electricity goes off for good.

One day, when I was talking to my neighbor about the old root cellars our great-grandparents and grandparents had, I learned that he actually managed to build one by himself. And he's a 70 years old Vietnam veteran who lost a leg during a field operation. So, after kindly sharing his amazingly-easy and economic method, I decided right there and then to build one for myself.

This book is the story of how I did it.

Just imagine the exact spot in your yard where you'll soon have an old-fashioned root cellar. As you walk down the stairs the cool air inside will take you back at least 100 years, to a time when almost every house in America had a cellar just like it. Almost everything our great-grandparents grew, bought or bartered for ended up being stored in their root cellar, where it would stay fresh. Today this ancient technology works as well as ever, with the added bonus of giving you a great shelter from storms or nuclear attack.

In the following chapters you'll learn:

- ✓ How to choose the ideal site for a nuclear shelter
- ✓ Cost-effective building methods that don't need professional skills
- ✓ Protecting your bunker from blast and fallout
- ✓ Concealing your survival refuge from prying eyes
- ✓ Providing basic life support – at a price anyone can afford

I will also show you exactly what to store in your shelter so that you have everything you need to stay safe inside for three months.

Plus, as a bonus, you'll find my personal guide to surviving in your shelter after a nuclear blast.

Chapter 1:

Finding the Right Location

It's important that you build your bunker in the right spot. Putting it in the wrong place can drastically reduce the protection it gives you, as well as making the job of building it a lot harder. There are three things to think about when you're deciding where to put it:

1. Soil type
2. Safety
3. Concealment.

Soil

The type of soil you have will play a big part in how long it takes to construct your cellar, how much energy you have to put into it and how strong it will be when it's completed. Well drained, sandy soil is easiest to dig in and reduces problems with water – but if it's *too* sandy it will be unstable and you risk having the walls collapse as you work. Clay soil is heavy, hard to dig and holds water, but very stable. There isn't a lot you can do if you have the "wrong" type of soil, but dig experimentally at different places on your property; there can be major variations even in quite a small area.

If your property isn't flat, you'll find that the water table can vary a lot. On raised areas it will be further below the surface; in lower-lying parts you might find that you hit water before you get deep enough for your cellar. There are advantages to putting your shelter

in a lower piece of ground, so if you plan to do this dig an exploratory hole to the right depth first and see if the bottom is wet. If it is, you might have to change your plans.

On the subject of how wet it is, the weather can make a big difference. If there's been a lot of rain, or you're having cold weather, the job will be more difficult.

Safety

The safest place to put your cellar depends on what you want to use it for. If it's only going to be a root cellar it doesn't matter – just locate it where it's convenient. If you want it to double as a nuclear bunker then safety becomes a lot more important.

First, don't put it where a building could collapse on it. A well-made bunker will survive having your house fall on it, but that won't help if the entrance is covered with a hundred tons of rubble. The last thing you want is to survive the nuclear apocalypse but then be entombed underground because you built your shelter in the wrong place.

Consider what potential nuclear targets are within five miles of you. These include military bases, airports, docks, major road or rail junctions and command posts. The direction of these likely targets is the direction any nuclear blast waves, heat and radiation will be coming from. If you can put high ground between them and your bunker that will give you extra protection, but there are also dangers.

Look at the height of your home and other surrounding buildings. If they collapse they're likely to deposit heavy rubble – enough to seal the door of your shelter – up to half that distance in any direction, but the full distance on the side away from the targets.

So, if your house is 30 feet high, and it's between where you want to put your bunker and the local USAF missile base, make sure the entrance is at least 30 feet from the house.

The blast from a nuclear weapon can damage other things, too. A tree falling on your shelter entrance can block it pretty well. Shock waves transmitted into the ground can collapse unstable slopes and break underground pipes. Try not to put your shelter near a water or gas main; these could either flood it out or fill it with explosive gas.

Don't forget other hazards. Your cellar also makes a great storm shelter, and will protect you from the strongest tornado or hurricane. These natural catastrophes can demolish almost any building, but not your bunker. You'll also have somewhere safe and comfortable to stay in the aftermath; you won't find yourself crowded into some high school gymnasium with your less prepared neighbors.

If you live in an area that's affected by hurricanes you'll already know that rain is one of their most dangerous features. Don't build your shelter in a spot that's vulnerable to flooding – you don't want it to start filling up with water. And, of course, a hurricane or tornado can collapse your house just as thoroughly as a nuclear weapon can.

Concealment

A nuclear bunker certainly isn't something you can build surreptitiously; your neighbors are going to know that you're working on it. However, once it's finished there are advantages in keeping it as low-key as possible. If you're using it as a root cellar this will help prevent thieves making off with your potato supply; they can't steal vegetables they don't know are there. And, if the air

raid warning goes off, it means you won't run to your shelter and find it's already full of people who were walking past at the time and thought, "That looks like a good place to hide."

No matter how bad things get, a well-hidden shelter will be a safe refuge for you and your supplies. Even if you're surrounded and outnumbered you'll have a place where nobody can find you – and FEMA can't seize and redistribute your supplies if they can't find them.

How you conceal your shelter will depend on what type it is. We'll cover this in more detail later, but as a quick summary, here are your options:

An above-ground shelter is the easiest to build but the least survivable and the hardest to conceal. If the water table is very close to the surface, or the ground is extremely rocky, you might have no choice but to build an above-ground shelter. Unfortunately, it's going to be pretty obvious what it is. You can hide it among trees, but that risks having them fall on it. Alternatively, put a fake shed over the top – keep it lightweight – or plant tall, fast-growing plants like bamboo around it. Don't forget to leave a path to the entrance!

An underground shelter is the easiest to conceal, but the hardest to build. You'll need to move a lot more earth, and it's also harder to arrange light and ventilation. Putting in a second entrance will also be much more work.

A partly underground shelter (which is what we'll be looking at in this book) gives you the best of both worlds. Our shelter was specifically designed to be easy to conceal. It's much less obvious than an above-ground one and easier to disguise as a garden feature. There's no prominent entrance, just a hatch that can be easily disguised. The shelter itself can be landscaped to make it invisible.

If your shelter does get found, it's easy to defend. The entrance is at the end of a tunnel, and anyone trying to get in is very vulnerable. Persistent looters might find the door, but that's not going to help them much if you're waiting in the shelter with a gun. There's just no way for them to get all the way through the door and start shooting at you before you shoot them.

Fortunately, I'd already picked out a spot on my land that was just perfect for building a cellar. The soil was a mix of earth, sand and small rocks that was quite stable, well drained and easy to dig.

Chapter 2:

Planning The Shelter

Once you've decided where to put your shelter, the next stage is to plan exactly what you're going to do. Just starting to dig isn't the way to go; you'll end up having to do a lot of extra work as problems appear during the build.

At the same time there's no need to plan down to the last detail; this isn't a professional construction job, and you'll probably have to improvise at some points.

What you do need is a clear draft of what you want to build, how big it's going to be and where the key features will go.

How Big Should It Be?

First, how big of a cellar do you want? A root cellar can be as large or small as you like, but for a survival shelter you'll need adequate space for essential supplies plus all the people who're going to be using it.

When the USA planned for civil defense in the 1950s the standard allowance was ten square feet per person.

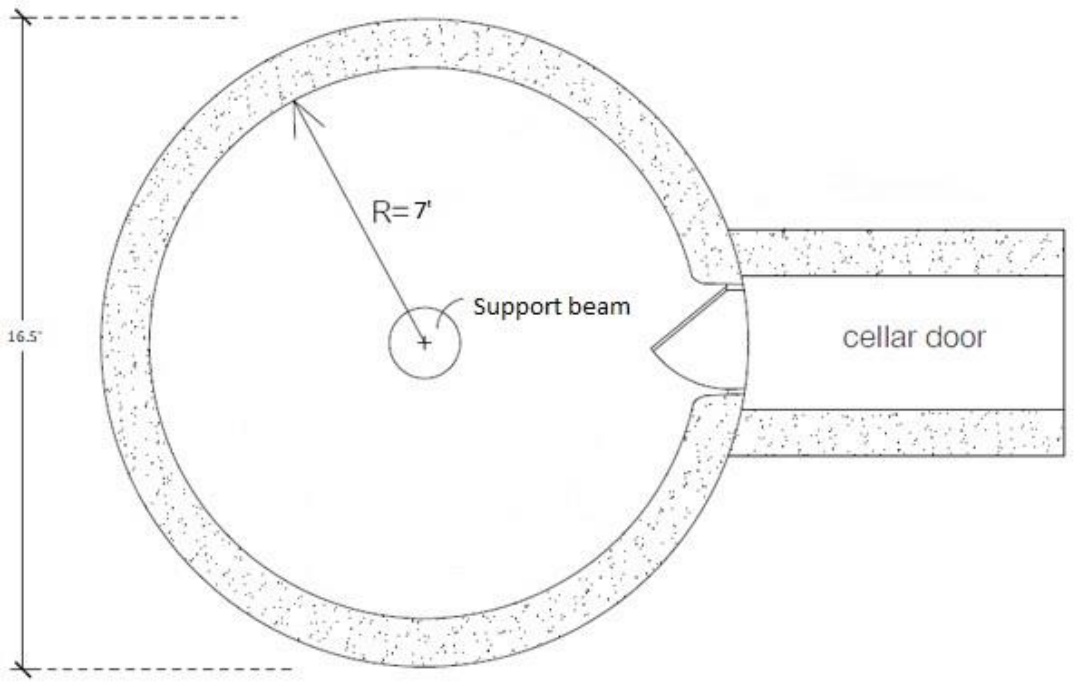
This is just about adequate, but it's *very* cramped, so if you can manage a bit more space that's a bonus.

I decided to go for a circular shelter with a straight corridor leading to the entrance. The outside diameter we settled on was 16.5 feet, while the inside diameter was 14 feet. That adds up to a total living space of just over 150ft², not including the corridor and stairs. I wanted the walls to be 6.5 feet high, with three to five feet of that below ground level. The dirt excavated from the hole would be kept to backfill the walls, reinforce the above-ground portion of the walls and cover the roof.

What About The Shape?

You can build a shelter in any shape you want, but a circular one has advantages. It doesn't use space quite as efficiently as a rectangular one, but it's stronger; corners can become weak points in the design.

The blast from a nuclear weapon will also tend to flow round the above-ground part of a circular shelter's walls, but straight walls resist it and are more likely to fail.



The straight corridor is a compromise, but a necessary one. You don't want the entrance to lead directly into the main shelter. One of the main hazards you need to protect against is radioactive fallout, and the key to that is to be surrounded by a layer of dense material.

The walls and roof of the shelter will be thick and dense enough to block most of the radiation, but the door is a lot thinner. If it opens straight into the shelter radiation is going to get through.

Putting the entrance at the end of a tunnel minimizes the risk; the door will be horizontal, and radiation from fallout lying on it will stay in the tunnel. As long as you don't spend time in there you'll be well protected.

If you need to go outside while radiation levels are still high the tunnel also gives you a space to clean fallout off yourself and remove protective clothing, so you don't need to bring it – and any radioactive particles it's carrying – into the main shelter.

The height is also a compromise. For maximum protection against blast and fallout the best option is a shelter dug deep underground and covered with at least ten feet of earth – but that's a major, and expensive, engineering job that's going to be unachievable for most people.

Going down three to five feet *is* achievable, and still gives good protection.

If you have to shelter from nuclear attack and fallout, you'll be spending at least two weeks in your bunker. The chances are you'll spend most of that time sitting or lying down – you'll want to conserve energy, because food is likely to be limited, and there won't be a lot to do anyway. And if you're sitting down or lying on your bed, you'll be below ground level and better protected from radiation.

Yes, a fully underground shelter is ideal, but this way you still get very good protection for a fraction of the work.

What Features Does It Need?

Depending on how much digging and fitting out you're willing to do, there aren't any limits to the facilities you can add to your cellar.

Want a fully equipped kitchen powered by a generator?

You can do that.

On the downside, the more you add the more it will cost and the more work will be involved. I decided to stick to the essentials.

Living in a confined space for days or weeks, things can get smelly quickly.

My priorities were sanitation, for both health and comfort; a ventilation system, to deliver fresh, safe air and extract stake air; and storage space for essential supplies.

I ended up building a simple but functional bathroom that has everything you need to stay clean for long periods – and it took me less than an hour to build!

I added an unpowered – which means failure-proof – ventilation system, which is one of the things I'm most proud of.

It's a tweaked version of a simple basic concept, and it will even work against radioactive fallout.

I put in some shelves to store food and other supplies. I also tried out another couple of ideas which I'll cover later in the book.

Once I decided on the size and shape of the cellar, and how it would be equipped, it was time to get to work!

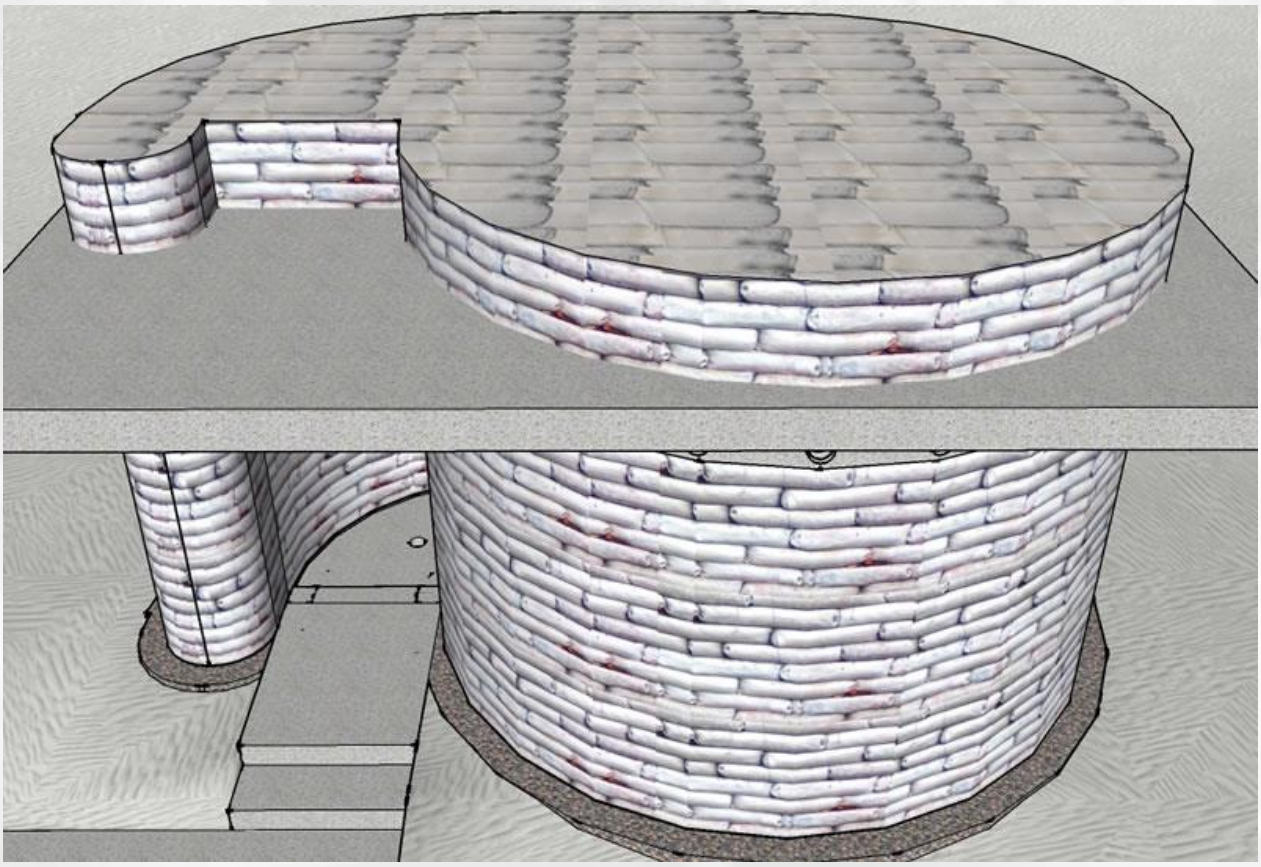


Fig. 1: Example of circular cellar

Chapter 3:

Digging The Hole

The biggest part of the job is digging out the hole for your shelter. For this one, allowing for the size and depth of the hole, the shape of the ground and an extra 18 inches of space outside the walls to give us room to work, it involved moving close to 1,400 cubic feet of soil. That's a major task. Just to give you an idea, a cubic foot of soil is about six shovels' worth and weighs 80 to 110 pounds, depending on the type of soil and how wet it is.

To put that into perspective, excavating our hole by hand would mean shifting over 55 tons of soil. That works out at about 8,500 full shovels, some of them having to be lifted from five feet down. It

sounded like a lot of digging, but luckily my neighbor had a handy skill that we decided we could use. So, I hired a backhoe.

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Even a small excavator makes a huge difference to the job, and you can hire one for less than $250 a day – which is as long as you'll need it for. When mine arrived and I got it fired up, assisted by my neighbor, I cleared away the topsoil from the area I'd marked out, then started to dig. I began by digging out a small circular pit to the right depth, then slowly expanded it outwards.

Doing it this way lets you get away with a compact excavator, which is cheaper to hire. If you start by digging out the whole area then making it deeper, you'll eventually run into a problem – the arm won't be able to reach all the way into the center and down to the depth you need. You'll want to allow a safety margin too. It's not a good idea to have the backhoe standing right at the edge of the hole, in case the wall collapses and it falls in with you in the seat. So, work safely; dig a small hole to the full depth, then back the excavator up and work round the outside, making it larger.

Once I'd expanded the hole to the full size, I tidied it up with shovels. First, I did some work on the walls. These sloped inwards, so I cut them as close to vertical as I could get to maximize the usable area. Then I levelled the floor as well as I could and shoveled out all the loose earth the backhoe couldn't grab. Once the main shelter was excavated, I started with the entrance corridor. This was 13 feet long and had an internal width of 3.5 feet. That gave it an external width of five feet, and again I left 18 inches on the outside.

All this digging took me a day, which showed me just how sensible I'd been to hire the excavator. Doing it by hand would have taken me at least two or three days of very hard work. Instead, I was able to move on to the next stage on day two of the project.

Chapter 4:

Preparing The Hole

With the hole dug, there were a couple of things I had to do to prepare it for building the actual shelter. I wanted to install a support post to strengthen the roof, so I located the center of the hole and hammered a stake into the ground. Then it was time to mark out the location of the walls.

The internal diameter I'd decided on was 14 feet, so I tied a loop in a rope, dropped it over the stake then tied another stake to it seven feet away. Then I simply stretched the rope out and scraped the second stake round in a full circle, marking out where the inner face of the walls would be.

The problem with a line scratched in the dirt is that it's not very durable.

A rain shower, or just my boots as I worked in the hole, would quickly

obliterate it. So, while the line was clear, I put down a more solid marker. I had decided to build the cellar from sandbags – I'll discuss that in the next chapter – so for now I laid a single row of sandbags around the outside of the circle.

When it came to the entrance corridor we marked out a pair of straight lines for the walls then, again, laid a single row of sandbags down each side and across the end.

That showed me the shape of the cellar I was going to create. It also showed another problem!

Digging out a perfectly shaped hole with a backhoe is not easy, and I hadn't quite managed it. In some places, like the end of the corridor where I would be building the stairs, the sides of the hole were too close to the outside of the walls.

I needed some space on the outside, because I would have to work in there to install the rain proofing I had planned, so I got my shovels out again and cut the walls back where that needed done.

Mostly this involved bringing the walls closer to vertical. It did weaken them slightly. The soil is quite sandy, so there was a danger that the walls could collapse before I'd finished building.

I avoided that by being careful not to walk too close to the edges of the hole when I was working at ground level.

Once the hole was perfected, I set to work on the center post. To make this I'd bought a stripped log, six inches in diameter and just over eleven feet long.

The post itself would be 6.5 feet high and I wanted to set in 20 inches into the ground for security. I measured a 98-inch length and cut the log in two. That gave me the post itself and a three-foot offcut that I kept for making the foundation.

The roof of a cellar carries a lot of weight once it's covered with soil, and if you plan to survive a nuclear attack inside then it needs to be able to handle the pressure of the blast, too. That means I wanted a really solid base for the support post, and I didn't think simply digging it into the soil was going to be good enough. It would be too easy for it to shift if I did that, so I decided to make a concrete base.

In the center of the floor, where the marker stake had been, I used a pick and shovel to dig out a square hole 18 inches on a side and 20 inches deep. We built a frame round the top of that with some pieces of board and stood the log offcut in the hole. This needs some care; it had to be right in the center of the hole and, most importantly, absolutely vertical.

I checked that with a plumb line – just a small weight on the end of a string – then set the log in position with a couple of taps from a hammer. A final check to make sure it was still vertical and we were ready for the next stage.

I mixed up a bucket's worth of concrete and used it to fill in the hole around the log. I tamped it down well as I filled in, to make sure the concrete was solidly bedded in the earth, and levelled off the top as neatly as I could. Then I left it for a few minutes before pulling the log out, leaving a perfectly sized hole for the central post.

With the post hole prepared, I just had to let the concrete set and cure. While it was doing that, I covered it with some plastic. Now I could see the general shape of the shelter. Here's how it looked from the spot where the entrance would be built:

Scan the QR code above to see the video

And another view, looking down into the main room:

This already looked like progress, so I set to work building the walls.

Chapter 5:

Building The Walls

As I said in the last chapter, I decided to build the walls out of sandbags. There were a couple of reasons for that. First, it's a lot cheaper than brick or concrete blocks, and you don't need bricklaying skills to do it. It's much easier to build shapes that aren't all straight lines. Compared to poured concrete the difference is even larger.

On top of that, sandbags are actually a great construction material. They're economical, extremely versatile and the empty bags are light and simple to transport. They also let you use the soil you dug out of the hole as building material.

When it comes to protection sandbags are also a great choice. There's a reason the military use sandbags to build fighting positions; a bag of packed earth is dense and resilient, and can soak up rifle bullets easily. They're also dense, which is ideal for absorbing radiation, and the flexible bags naturally form into a wall with no gaps in it.

Old-style burlap sandbags deteriorate over time, especially if they get damp, but modern ones last for many years. The military often use rubberized ones, but I opted for polypropylene ones.

These are strong, UV-resistant and cheap. The bags I bought were 18x30 inches and I got 800 of them, figuring I'd need around 700 for the shelter walls and stairs.

These bags come with cord seals ready attached, but I decided not to use them. Firstly, it would have taken a lot more time if I had to tie each bag individually; second, tying the neck closed can make it harder to stack the bags really close together, and I wanted to do that to close off any gaps in the wall.

Instead, as I placed each bag I folded the top underneath so the weight of the bag itself would keep it closed. Sandbags shouldn't be filled all the way – aim for about three-quarters full.

That let us tuck around five inches of material under the bag, which turned out to be nicely secure.

The polypropylene bags have a fairly smooth surface, and while it's fine for normal use, I wanted this shelter to be as tough as I could make it. So, to prevent the bags slipping if a lot of force was applied to them, I decided to lock them together.

I got a roll of barbed wire and laid two rows of it around the first layer of sandbags.

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This is when heavy boots came in handy; I stamped the wire down onto the first layer of sandbags so the barbs got a firm grip. You can also knock the wire in with a rock or hammer, but this takes a lot longer. Another option is to lay a board on top of the wire and walk along it. The important thing is to push the barbs solidly into the bags. Once that was done, I laid the next layer of bags on top, overlapping them halfway like bricks, and pounded them down firmly. Each bag, after being filled and placed, measured about 20 inches long and 14 inches wide. They made good solid bricks, and it was possible to get them close enough that there were no real gaps between them. Just a few seconds snugging each one up to its neighbor then flattening it down gave us a very nice, tight wall.

I kept building up, laying barbed wire on each row of bags to lock them. After a few days, I reached ground level.

So, I decided it was time to add the first weatherproofing sheet. Sandbags are pretty good at keeping water out, but not perfect; you can use them to protect your home during a flood, but eventually water will soak through them and the inside will become damp. Then, because sandbags can absorb a *lot* of water, it will stay damp for a long time as moisture evaporates, turning the interior cold and clammy.

For a root cellar this is a problem, but for a nuclear bunker it's a *huge* one. Rainwater seeping in can bring radioactive particles with it, and you need to keep those as far away from you as possible, so weatherproofing is essential for more than just comfort.

The simplest way to weatherproof your cellar is with plastic sheet. I bought 10 feet wide,135 feet long roll of heavy sheeting to seal the walls, and an even heavier 16.5x16.5-foot tarp for the roof.

First, I measured the perimeter of the shelter, including the corridor and entrance; that came to 81 feet. I cut another 13-foot length for the roof of the

entrance corridor and set that aside, then I went to work on waterproofing our walls.

I carefully positioned the plastic around the walls, leaving 18 inches free at the bottom to cover the gap between the wall and the side of the hole. This helps prevent water that seeps down right next to the wall getting underneath. I shoveled some soil on top to anchor it as I worked and prevent it shifting.

You can see here how close the stairs were to the side of the hole; this is one of the places we had to dig out. Again, once I'd got the sheet in position I put some more soil on it to hold it in place.

The reason I chose to put the weatherproofing on at this point was that the walls and the ground were at roughly the same level, which made it easier to work in the gap between them. From now on I had to work around the weatherproofing, but that was easy enough. All that's needed is to move one section of sheeting off the top of the wall as the next layer of bags goes on, then replace it and move on to the next section. The sheeting also gave some protection to the project; weighted down with some timber when I wasn't working, it stopped the sandbags from getting soaked if it rained.

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Chapter 6:

Finishing The Walls And Starting The Roof

The way things turned out, it was a good job I fitted the weatherproofing when I did; it rained for two days straight, which slowed down the work on the walls. Another three days was enough to get them fully built up, though, and I was at the 6.5-foot height I'd been aiming for. By this point it was quite awkward to work inside the shelter; I made a crude ladder so we could get in and out more easily.

At this point it was getting a bit windy, and the plastic sheeting was blowing around. As the walls were now at their full height I tacked the sheeting down

onto the sandbags with a few nails, and I also shoveled some more dirt around the outside of the walls.

Reinforcing The Walls

Next, I strengthened the walls by pinning them vertically. This isn't really necessary with a normal sandbag wall, but because I want this cellar to withstand a nuclear blast if it comes to it, I decided to add some extra reinforcement.

I bought ten lengths of half-inch rebar – four at 8.2 feet long, and six at 9.8 feet.

Starting with the long bars, I marked out equally spaced six spots around the circular room. Then we placed a rebar on each spot and knocked them right down through the walls with a hammer.

I decided to drive them in at 15° from the vertical so they would fix the maximum number of sandbags, and each bar was driven into the ground until the top end was flush with the top of the wall.

The rebar also fixed the weatherproofing more securely. The four shorter lengths were used to reinforce the entrance area in the same way.

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Building The Stairs

Now I decided to install the stairs. For maximum strength and simplicity these were made from sandbags too. I just laid a layer of sandbags on the floor of the corridor at the entrance end, then put another, slightly shorter layer on top, and worked our way up to ground level. The progressively shorter layers formed the steps, and I ended up with a slightly rough, but very stable, flight of steps.

I built the stairs completely out of sandbags, but you could save some work by shaping an earth ramp at the end then laying sandbags on it to form steps. This isn't quite as stable – it could collapse if there were ground tremors, from an earthquake or nuclear explosion – but it would save you about 50 sandbags.

By this stage in the project I'd filled a *lot* of sandbags, and skipping few was tempting! In the worst case, if you do go with an earth ramp and it collapses, you'll still have a pile of earth you can climb up to reach the door.

Another option would be to build a set of steps from wood. I did consider that, but the entrance is the weakest spot in the bunker. It's hard to avoid having *some* flammable wood around it, but I wanted to minimize it as much as I could.

Installing the Roof Supports

By the time all this was done the concrete base for the support post was fully cured. Now I was ready to fit the post itself.

I tested this in the hole, and it fitted easily.

In fact, it was slightly loose, because the concrete had shrunk a fraction as it cured. That was no problem; I positioned the post in the hole, making sure it slid all the way to the bottom.

Then I checked it with the plumb line again to make sure it was vertical and rammed some earth down around it to hold it securely in place.

The final preparation before I started on the roof was to fix planks on top of the walls. One weakness of the sandbags is that it's hard to get a completely flat top surface on them, and an uneven top surface would make the roof harder to build.

It could also have weakened the final structure, and I was determined to avoid that.

To give a flat top, I bought a load of one-inch planks in two lengths. Six 13-foot lengths were for the corridor, which thanks to its straight sides was easy.

The circular room was trickier. As a compromise between minimizing the number of planks, and matching the shape of the circle as closely as possible, I settled on 4.5-foot planks, and I bought 20 of these.

To fix the planks I simply laid them on top of the wall then nailed them to the top row of sandbags. In a few places the top of the wall was lower, because the floor of the hole was slightly uneven or just because sandbags aren't precision components. All I did here was add another layer of planks to even off the height. In fact, at the entrance I ended up using three layers. And that was me ready to start on the roof.

Chapter 7:

Building The Roof

To support the roof, I used 2x5-inch timber. The first one of these was laid across the shelter from side to side, standing on a narrow edge and with the center resting on the support post. Then I laid out the others to either side of it, measuring and marking 19.5-inch gaps between them, and working all the way to the back of the shelter and half way up the corridor.

At this point I used a spirit level and string to check that the beams were horizontal and the whole roof surface would be flat; that needed a few adjustments to the planks on top of the walls.

Scan the QR code above to see the video

Once I were satisfied with the positioning I fixed the beams down with 60D nails, driving them right through the supporting planks and into the sandbags. This added some extra stability to the whole structure as well as securing the beams.

The center beam was also nailed to the top of the support post.

To brace the beams and spread the weight of the roof more evenly I cut some 19.5-inch lengths of 4x2, and nailed these between the beams with 20D nails.

Once everything was secure I got my saw and worked round the outside of the wall, cutting away all the excess timber that was sticking out over the edges. That completed the structure of the roof.

Scan the QR code above to see the video

I used the remaining 5x2 to build a doorframe over the stairs at the end of the corridor. This doorframe was nailed to the last of the roof beams and the planks on the wall.

For the roof covering I bought twelve 8-x-foot sheets of 8mm OSB.

This is an economical, but tough, material that's very good at carrying a load. Starting from the center of the shelter I laid the sheets out to cover the roof, butting the edges tightly together, and nailed them to the beams and cross-braces with 8D nails.

Finally, the whole shelter and the corridor, apart from the door frame, were covered. I then cut the OSB to match the outline of the cellar.

The joins between the OSB sheets were tight, but not waterproof; the OSB itself will also eventually deteriorate if it's constantly damp. To keep water away from it and out of the shelter we used the 16.5x16.5 tarp I'd bought.

This was placed over the top of the shelter, but not nailed down – putting holes in your roof weatherproofing isn't a great idea. Instead, I backfilled around the outside of the walls until there was enough earth to hold the corners in place. For extra security we weighed it down with chunks of timber while we worked.

The 20-foot length I'd cut from the roll of wall weatherproofing covered the roof of the corridor, with the door frame cut out. Now it was time to fit the door. This is a simple cellar door, made from a sheet of OSB and carefully cut to be a neat fit in the frame. I secured it with three hinges down one side.

Finally, the cellar looked like this:

From the outside it was quite impressive, and now I could also go inside to see how it looked from there.

There were small gaps around the top of the walls, where the beams held the roof a few inches above the planking. These weren't a problem, as when the shelter was finished they would be covered by the tarp and buried under the soil top fill. For now, they were quite useful, giving me more light to work by as I started to fit out the interior.

Scan the QR code above to see the video

Chapter 8:

Building The Bathroom

If you're spending two weeks in a shelter, and the only sanitation you have is a bucket with a lid on it, the atmosphere inside is going to get quite unpleasant. You need to have some kind of proper toilet, as well as basic washing facilities to maintain hygiene. Poor hygiene will increase the risk of bacterial disease, and in a confined space, once one person gets sick everyone else is likely to get it too.

I looked at several options for a toilet. The most obvious one was a chemical toilet. These are easy to find and work well, but they also have drawbacks. The main one is that they need a supply of chemicals, which then have to be changed regularly and disposed of. With the average toilet holding a couple of gallons, and needing to be emptied every two or three days, this is a significant disposal problem.

Another factor was that I wanted, as much as possible, to make everything myself. Luckily here was a solution – a composting toilet. These are simple to make and economical. The waste is easier to dispose of than chemicals, and in fact will gradually break down into a natural fertilizer that can go on your garden after two or three years. Properly built, they're almost odorless – about the same as a standard home toilet – and they don't use water.

The principle of a composting toilet is simple. Instead of using chemicals to neutralize and conceal the odor of toilet waste, they use natural aerobic processes to treat it.

When waste breaks down normally it becomes a breeding ground for bacteria that release smelly gases; a composting toilet short-circuits that by encouraging different bacteria which don't smell and create fertilizer as an end product.

All you need to do to get the right bacterial processes going is prevent the toilet contents from being too moist and get the right carbon-nitrogen balance.

Usually there's too much nitrogen in toilet waste, which is why it gets smelly. Adding some organic matter will change the balance and give the result you're looking for.

There's a wide choice of suitable matter, which makes these toilets very versatile. Sawdust, peat moss, dry grass or paper will all work very well.

Creating The Toilet

My aim was to make my toilet from cheap or scrap materials, so I bought or scrounged the stuff on this list:

- Three plastic buckets
- One plastic barrel with lid
- One paint bucket
- One toilet seat
- One chair (I used an old toilet chair)
- One plastic water container tap
- Two bike wheels
- Two shower curtains
- Scrap planks and OSB

I also collected the tools I would need, which amounted to a power drill, jigsaw, hammer and screwdrivers, plus screws, nails, rope, fencing wire and sandpaper.

I started off by cleaning up the chair. I used an old toilet chair, because it was ideal for the purpose, but almost any chair can be adapted.

For example, you can remove the seat of an old dining chair, or cut a hole in a plastic garden chair. In my case I removed the wheels, went over the steel frame with fine sandpaper to remove some rust it had collected, then spray-painted it.

Scan the QR code above to see the video

While I was waiting for the paint to dry, I made the waste storage barrel. This is what the toilet gets emptied into, and it's where most of the composting process will take place. Because it's an aerobic process there needs to be airflow into the barrel, but at the same time I wanted to have a lid on it to keep flies out. The solution was to drill small holes in the lid – the more, the better.

I also wanted to have a convenient water container in the bathroom area, for hand washing and general hygiene. For this I chose an old paint bucket, because it has a tightly fitting lid. To convert it into a water dispenser I simply cut a hole in the side and fitted the tap.

Scan the QR code above to see the video

To give some privacy to the toilet I made a curtain to screen it. As a frame for this I used two old bike wheels I'd salvaged. To start off I removed the tires, placed the wheels side by side and laid a plank over the top. Next, I marked the plank at the centers of the wheels' axle bolts. I drilled holes for the bolts, then used the wheel nuts to fix the wheels to the plank.

By this time the paint on the toilet chair had dried, so I set to work on that. This is the main component of the toilet itself. First, I refitted the wheels, then looked for other details I could fix. The padding on the arms was ripped in a few places, so I wrapped the damaged areas with duct tape. As well as looking better and being more comfortable, this makes it easier to keep the chair clean.

Next, I cut a strip from an old car canopy and used PVC clips to fit it round the bottom of the chair. This conceals the bucket that will go underneath, which is just a minor comfort touch, but it didn't take much work so I thought it was worth doing.

I also installed a toilet seat. Because this was a toilet chair I could have got away without fitting one, but then I'd have had to make and fit some kind of cover for the hole in the chair.

Using an actual toilet seat provided a lid, and also made it more familiar to sit on.

I simply placed the seat on the chair, marked it then glued it down.

That completed the chair, so I took it down into the cellar and wheeled it into place in the area I'd designated for the bathroom.

This was inside the main shelter, just to one side of the corridor. I decided that was the best location because it made it easier to move waste out.

With the shelter fully occupied you wouldn't want to spill a barrel of waste trying to navigate through people and their stuff.

The chair looked quite good sitting there, but I wanted to hide it with the shower curtains. I put a length of wire around the rims of the bike wheels, giving me an oval frame, which I then fixed to the roof beam above the toilet with two more pieces of wire.

If the wire turns out not to be strong enough I'll replace it with metal L brackets, but so far, it's holding up well.

Then I simply used hooks to fix the shower curtains to the wheel rims and wire. That gave me a small private space surrounding the toilet.

The finishing touch was to put an inch of sawdust into a bucket and slide it under the chair. Another bucket full of sawdust, with a small scoop, was placed in front of it.

This toilet works like an old-fashioned outhouse, except instead of throwing lime down the hole after using it you scoop some sawdust in to cover the waste.

That absorbs moisture and encourages the aerobic processes that will eventually turn the waste into compost, instead of a bad smell.

When the bucket starts to fill up it can be emptied into the barrel, which I placed conveniently in front of the toilet. I put a layer of sawdust in the barrel, too.

Finally, I hung the paint bucket above the barrel from the shower curtain frame with a piece of wire, and filled it with water.

That gave a supply of water for hand-washing, with a tap so it can be used more efficiently than pouring from a bottle – water needs to be carefully rationed in a shelter.

I placed my third plastic bucket on top of the barrel to collect the water, creating a simple sink.

And here is the finished bathroom:

Chapter 9:

The Ventilation System

Ventilation is essential for any living space, especially a fully enclosed one like a nuclear shelter. The problem is, you can't just open the door when the air inside gets a bit stale – because along with the fresh air you'll let in lethal radioactive fallout.

I needed to develop a way to bring in fresh air without opening the shelter up to outside hazards.

The ideal way to ventilate your shelter is with a forced air system, drawing in fresh air through a HEPA filter installed in an armored, protected box. Unfortunately, this isn't cheap – it would cost thousands of dollars to install – and it's not simple either.

Apart from anything else it needs a power source, so you'd need to add a generator. A generator means significantly enlarging your shelter to create a separate room for it, plus a fuel store.

I was building a fairly small bunker, though. It wasn't as if we had to pump filtered air through a complex of underground rooms. An unpowered ventilation system would be adequate, and a lot simpler and more economical.

So, I studied the shelter and its location, and came up with a plan.

What I decided on was a basic system that would bring in fresh air and extract stale air and any odors from the toilet.

For simplicity, this would be made from standard PVC drainpipe.

This is cheap and easy to work with, and it's also a tough, lightweight material. So, I bought some long lengths of six-inch pipe, two T-connectors and three elbow joints, and went to work.

I started with the air intake. This was based around a three-foot length of pipe pushed out through one of the gaps between the roof beams.

To do this I cut a hole in the weatherproofing that fitted the pipe exactly.

I fastened the pipe to the roof beam with wire to hold it firmly, then sealed it to the weatherproofing with silicone to prevent any leaks.

I connected a T-piece to the inside end of it.

Next, I ran a 13-foot length of pipe from the T-piece right across the cellar; again, I wired it to the roof beam. I cut a 5.5-foot length of pipe and fitted it to the T-piece, pointing down.

This is the pipe that will bring fresh air into the shelter, and I ran it down almost to the floor to prevent stale air settling there.

Scan the QR code above to see the video

At the other end of the long pipe I fitted the second T-piece. An elbow joint went on here, pointing down, to extract bad air from the main shelter. On the other side of the T-piece went a length of pipe leading through the shower curtain and into the toilet.

I cut that pipe so the end was above the barrel and fitted another elbow joint to it. This was positioned to catch any gas or odor that does escape from the barrel, and it also completed the basics of my ventilation system.

Filtering

Once I had all the pipes installed the system worked well; the air inside didn't become stale, and it always felt fresh. For a root cellar this is pretty much all you need to do, but as a nuclear shelter it has a big problem. Minutes after a nuclear attack, fallout from the explosion will start falling; then there will be a pause for a couple of days before a second phase of fallout, which can last for weeks, begins.

Fallout is very fine dust carrying radioactive contamination from nuclear weapons. It looks like normal dust, but it's deadly. It emits radiation which takes weeks to decay to a safe level, and if it finds its way inside your shelter you're in serious danger.

Completely protecting yourself from radiation is very difficult (and expensive) but the more you can keep away from you, the better.

If fallout gets in through your ventilation system, you're not keeping radiation away from you. The dust will get into every crack and corner of your shelter and linger there, emitting radiation. Even worse, you'll inhale some of it. You need to keep fallout where it belongs – outside.

Luckily, because it's dust, you can filter it out of the air as it flows into your intake – and you don't actually need expensive HEPA filters to do that. Any cloth pad that will stop normal dust will also stop fallout. The question was whether to put the filter outside the shelter, or inside.

Some research quickly settled that one. Filters on the inside ends of the system would stop fallout getting into the living space, but the fallout would collect on the filters themselves.

That would create radioactive hot spots inside the protection of the sandbags and soil, so although we wouldn't be directly exposed to the dust we would still be getting a high dose of radiation.

Because the air intake comes out through the side of the shelter it's close to the ground. This is bad news in a nuclear scenario.

Fallout settles on the ground, and unless the weather's wet any wind will tend to stir it up. A low-set air intake is going to be right in the middle of any radioactive dust that's being blown around.

To solve this, I used the third elbow joint and added a three-foot vertical extension to the pipe.

This lifted the intake well clear of the ground and above most of the fallout that will be disturbed by the wind.

Then I put a double layer of finely woven cloth over the top, plus a layer of burlap to protect it, and fastened it with a cable tie.

Fasten it down tightly to make sure the filter stays in place through a blast.

Scan the QR code above to see the video

The pipe itself should be fine, as the bottom of it will be held by the soil once everything is filled in. I'm planning to improve the intake slightly soon, by adding a U-bend to the top of the pipe. That will prevent fallout settling directly on the filter, or rain-washing particles through into the ventilation system.

Just as a backup, and in case the outside filter or pipe got damaged, I fitted similar filters to all the inside ends of the system.

Obviously, this isn't as effective and you don't want fallout being trapped when it's already inside your protective walls, but you really don't want it loose inside the shelter where you can inhale it and get it on your skin.

Finally, one tip for working with the pipe.

Getting the right lengths is going to mean cutting it, and once you've done that you might find it's quite hard to fit to the elbow joints and T-pieces.

Usually the ends of the pipe are slightly rounded or beveled so they'll fit easily into joints; on cut ends just get a file and put a slight angle on the plastic. Then everything should fit together easily.

Chapter 10:

Finishing It Off

With the ventilation system installed the cellar itself was basically complete. However, I was still left with a huge pile of soil beside it. Working out what to do with that didn't take very long, and the right answer is the same whether you just want a root cellar or you see it as a shelter, too.

Root cellars work because they're surrounded by a thick layer of earth that insulates the contents and keeps them at a fairly constant temperature. Even if the cellar is partly underground and has thick sandbag walls, like ours, sunlight on the roof will transfer a lot of heat inside. In winter, freezing temperatures will chill the air inside and your vegetables will freeze.

In a nuclear shelter you need to protect yourself against both the thermal pulse of an explosion, and radioactive fallout. Again, a thick layer of earth is an excellent defense against both of these.

Sandbag walls will protect you against the thermal pulse, unless the weapon is so close that you're inside the area of total destruction anyway, but what about fallout? That's going to land on the roof, and if all that's separating you and it is half an inch of OSB most of the radiation is going to come right down into your shelter. So, I'm sure you can guess what the solution to the big pile of dirt is – put it on the shelter.

Using the soil from the hole to backfill the walls and cover the roof would protect against both normal weather and nuclear weapons.

That meant it was time to hire the excavator for another day. However, before I did that, I finished off a few details.

I cut a leftover piece of plastic sheet to cover the door, leaving enough round the edges that I could fold it over the edges and tack it to the inside with small nails. Nailing it to the outside is quicker, but it creates holes in the weatherproofing that could let rain seep through and start to rot the OSB.

Scan the QR code above to see the video

Finally, I used the pile of earth to completely fill the gap between the walls and the sides of the hole. Then I banked up earth around the walls and started to spread the rest of it over the roof.

In the military, if you're building a fire trench or bunker with nuclear protection, the tactics manuals say you should have three feet of earth as overhead cover. This is ideal, and will keep out practically all the radiation from fallout that lands on top. It's a big job, though.

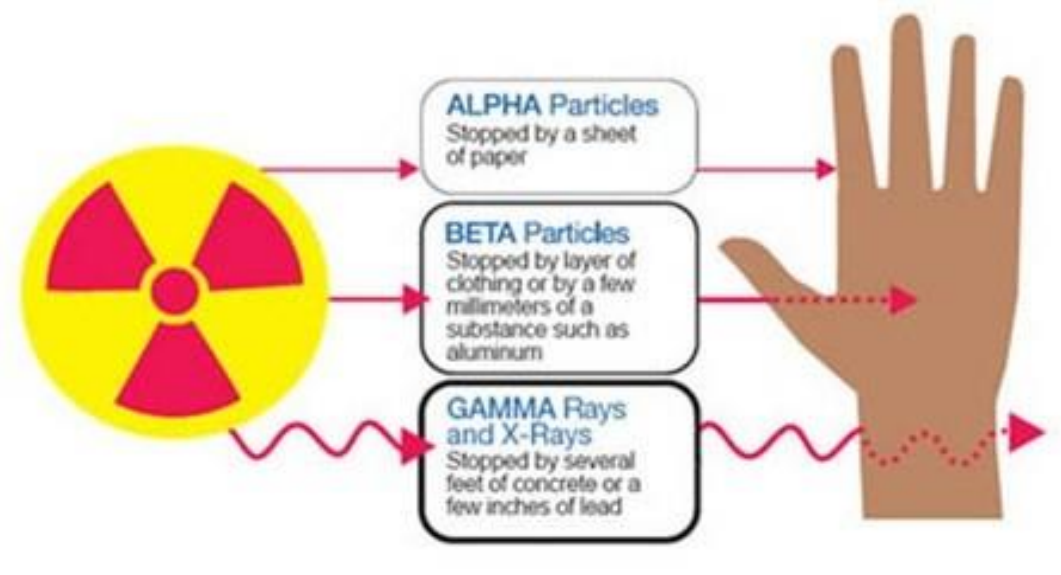
Apart from anything else soil is heavy. Putting three feet of top cover on our shelter would have added up to over 18 tons of earth, and I thought that might be a bit much for the roof beams and support post.

However, one foot will still give very good protection. Fallout gives off three types of radiation; some of it is gamma rays, but most is alpha and beta particles. Not all of these are equally good at penetrating.

Alpha particles are very bad at penetrating anything, although they're also extremely dangerous if you inhale them. The layer of dead cells on top of your skin will stop alpha radiation, so it has no chance of getting through your shelter.

Beta particles are more of a hazard. They penetrate better than alpha radiation, but not a lot better – a tenth of an inch of aluminum will stop them. There's a problem, though: as beta particles decelerate in matter they give off gamma rays.

The good news is that the less dense the material they're caught in, the lower energy the gamma rays. The dirt covering your shelter is a lot less dense than lead or even concrete, and the top inch of it will stop the beta particles dead. That leaves most of a foot to deal with any gamma rays they release.



Gamma radiation isn't made up of particles; it's electromagnetic radiation, like light, but it carries a lot of energy – even more than X-Rays. It also penetrates very well, so it's the most likely to get inside any shelter. It's almost impossible to completely block gamma rays without using hundreds of tons of lead, but a foot of earth will stop at least 90% of it, and even more if the soil is wet.

So, just covering your cellar with one foot of earth will make a huge difference. It will stop all alpha and beta radiation, and almost all the gamma rays. If you're above ground or inside a normal building when the fallout starts coming down, you have no chance of survival; inside this bunker, you're probably going to make it.

As a finishing touch, why not scatter some grass seed over the bunker? Grass will help conceal your bunker from prying eyes – but it will also help make it more durable. The roots will bind the top layer of soil, and make it much less likely that a nuclear blast will strip it off. If an attack comes in summer when the soil is dry, the high-speed winds of the blast wave can turn most of your precious top cover into flying dust. A layer of grass will hold it securely in place.

Finishing Touches

My bunker is now complete, and if World War Three breaks out tomorrow it will make for a safe place to wait out the worst of its effects. In fact, I've already tested it out!

I spent a week closed down inside the shelter, just to see if there's anything else it needed. I took a radio, but getting away from TV and the internet was actually pretty restful!

In fact, I'd have happily stayed in there longer, but I didn't want to put too big a dent in my emergency supplies.

There are still some finishing touches I'd like to add, though. Firstly, lighting – it's quite dark in there with the door closed!

I don't want to go down the road of installing a generator, because that means a lot more digging.

There's also the risk that a modern generator could be disabled by EMP. Even if dedicated EMP weapons aren't used, the effects of any nuclear attack will cause severe EMPs anyway.

I don't want to build a shelter that relies on systems which the first explosion will kill.

Because the cellar is ventilated, there's no problem with using candles or lanterns inside. They can be a fire hazard though, so instead of leaving them on the floor I'm considering fitting some hooks to the roof beams so I can hang lanterns safely out of the way.

A battery-powered LED lantern is also an option, but again it could be vulnerable to EMP – any LED light has some electronics in it.

Storage is also important, so I've built some shelves to hold essential supplies and keep them out of the way.

Stacks of gear on the floor become inconvenient when the shelter is occupied, and shelves also make it easier to find what you need without having to rummage through stuff.

I plan to add a curtain at the end of the corridor, to isolate it from the main living area. The door is where a small amount of fallout is most likely to get in, either round the edges or from people coming in and taking off their protective gear; a curtain will help keep it out of the main space.

Finally, some basic supplies are vital – we'll look at that in the next chapter.

Chapter 11:

Building Up Supplies

It doesn't matter how well-built your bunker is if you haven't equipped it with the supplies you'll need to stay alive. Starving in your bunker is no less deadly than being caught by the blast or fallout – it's just slower. To turn your completed bunker into a true survival refuge you'll need to build up an emergency stockpile inside, so that you can take shelter at a moment's notice and be ready to sit out the emergency.

How much you store in your bunker is up to you – if you like, and it's big enough, you can give it all the comforts of home. That will certainly make it a more pleasant place to spend a few weeks, but it's also expensive. It's best to focus on the basics needed to keep you and your family alive, then add any extras you can afford.

At a minimum, you have to cover all the priority items you need to stay alive – water, food, medical care and safety. Without water your survival time is measured in days. That means if you don't have enough to keep you going you'll have to make a choice with no right answer – stay in the shelter with nothing to drink, or go out into the worst of the fallout to find water that will probably be radioactive anyway. Whichever option you choose, your chances of survival are basically zero. You need to have enough supplies to last you until it's safe to come out.

You've probably noticed that, several times throughout this book, I've mentioned having to stay in the shelter for two weeks after a nuclear attack. This is because it takes that long for the radiation outside to fall to reasonably safe levels. Many people believe that a nuclear attack will poison the land for thousands of years, but this isn't really true.

After an attack, radiation levels will skyrocket – but they'll start to fall quickly. That's why Hiroshima and Nagasaki were rebuilt in just a few months, but Chernobyl is still a ghost town thirty years later. Impact craters will be dangerous for a long time, but as long as you avoid them the hazard is fallout, and its radiation falls exponentially.

An hour after the attack, in the downwind fallout area, radiation levels will be around 1,000 roentgens – high enough that less than an hour outside will kill you almost immediately. However, just seven hours later it will have fallen to only a tenth of that.

Radiation decay follows the 7-10 rule; seven times the time since the attack equals one-tenth the radiation. So, if it's fallen to 100R after seven hours, after another 49 hours it will be 10R – and you can survive a short exposure to that.

Two weeks after the attack you can spend several hours a day outside without serious risk, and after a year radiation will be close to normal pre-attack background levels.

This means that the bare minimum of supplies you need is two weeks – but that's cutting it very fine. What if nuclear attacks last for several days?

You could find your water running out, but it's only been a week since the last detonations; the world outside will still be lethally radioactive.

It's best to stock your bunker with three months' worth of supplies, or as close to that as you can manage. Let's break your essentials down into categories, and look at how much you'll need of each.

Water

Water is the top priority when it comes to supplies. You'll need a minimum of one gallon per person per day; that will give you enough for drinking, cooking and essential hygiene. Unless your bunker design includes a water tank, it's best to store your supply in military-style five-gallon jerrycans; these are tough, and their rectangular shape makes for space-efficient storage. They also seal tightly keep light out, which helps prevent bacteria or other organisms from growing in the water.

If you can't get jerrycans, bottled water will also work – but it needs more careful handling, because thin plastic bottles split easily. On the plus side it's easier to distribute; you can hand out bottles instead of measuring drinking water rations from a jerrycan. Buying bottled water will also probably be cheaper than buying jerrycans and filling them from the tap. On the other hand, once you have jerrycans you can use them for years.

To give yourself the minimum two-week water supply you'll need three jerrycans or 65 one-liter bottles for each person. A full three-month supply comes in at 18 jerrycans or 405 bottles per person. That's a lot of water, but without it you're not going to have much chance of survival.

One reason to aim for three months' worth of water is that, once your stockpile is gone, you're going to have to purify all the water you use – even for washing. Any water you collect is going to be contaminated with fallout, and some radioisotopes will dissolve. The only way to completely purify fallout-contaminated water is distillation, and that probably won't be practical. The longer you can keep using clean water from storage, the more the radiation levels will have fallen when you start having to collect and treat water. Even with activated charcoal filters you won't be able to get all the radiation out, so larger stockpiles will make a big difference in your total radiation exposure.

Activated charcoal filters are your best bet, though, so collect as many of them as you can. Don't forget water sterilization tablets or bleach, as well; after a nuclear attack there will be burst sewers and dead bodies all over the place, so bacterial disease is going to be a real hazard. Don't drink any water that hasn't been chlorinated – even if it comes from a source that's usually safe. After a nuclear attack there's no such thing as a safe water source.

Food

Storing food for three months is a challenge – but one you can overcome. The main thing to keep in mind is that you're stockpiling survival rations, not 90 days' worth of normal meals. You can achieve a lot with some inexpensive staples, and a few extras will add a lot of taste and variety to your diet.

Daily Calorie Requirement*				
Gender	**Age**	**Sedentary** [1]	**Moderately Active** [2]	**Active** [3]
Child	2-3	1,000	1,000-1,400	1,000-1,400
Female	4-8	1,200	1,400-1,800	1,400-1,800
	9-13	1,600	1,600-2,000	1,800-2,200
	14-18	1,800	2,000	2,400
	19-50	2,000	2,000-2,200	2,400
	51+	1,600	1,800	2,000-2,200
Male	4-8	1,400	1,400-1,600	1,600-2,000
	9-13	1,800	1,800-2,200	2,000-2,600
	14-18	2,200	2,400-2,800	2,800-3,200
	19-50	2,400	2,600-2,800	3,000
	51+	2,000	2,200-2,400	2,400-2,800

*Estimates were determined using the Institute of Medicine equation based on median height/weight and BMI of 21.5 for adult females and 22.5 for adult males.

[1] Sedentary = light physical activity associated with typical day-to-day activity

[2] Moderately Active = exercise equivalent walking 1.5 – 3 miles per day at 3-4 miles per hour

[3] Active = exercise equivalent to walking more than 3 miles per day at 3-4 miles per hour

Fig. 2: Daily Calorie Requirements
Source: MERCK Manual & USDA Dietary Guidelines for Americans, 2005

A balanced diet is always good, but when you're looking at preparing a survival bunker it's more a luxury than an essential. The first priority is to get enough calories to keep your body functioning. Carbohydrates are your friend here. You'll also need fat, protein and fiber, plus some basic nutrients. The good news is this can be achieved quite cheaply. In fact, you can stockpile basic, but reasonably healthy, rations for one person at a cost of about a dollar a day.

The core of your emergency ration supply is going to be dried goods. Rice and pasta are good sources of carbohydrates; dried beans and lentils add the protein and fiber. Aim for a pound of dried goods per person per day, broken down into 6.5 ounces of pasta, 6.5 ounces of rice and 3 ounces of beans or lentils.

Obviously, you don't need to eat exactly that every day – you can have pasta one day and rice the next, with beans added as and when. Get white, not brown, rice – the oil in the husks will make brown rice turn rancid. Avoid whole-wheat pasta for the same reason.

A three-month supply for one person works out at 40 pounds of pasta, 40 pounds of rice and 17 pounds of beans or lentils. This will give you around 1,700 calories a day – not enough, and also very unbalanced.

To increase the calorie count, and add some fat, go with canola oil. It's healthy, versatile and stores well. Two ounces a day will add 400 calories (and no cholesterol). To last 90 days, store 1.5 gallons of oil per person.

Finally, you can easily add more calories by simply storing sugar. Ignore any objections about sugar being "empty calories". So what? Calories are what you're looking for, and sugar is a great source of easily processed ones. An ounce of granulated sugar a day will add another 100 calories.

We're now looking at a total energy intake of about 2,200 calories per day. That's enough to keep you going at a fairly low level of physical activity – and you won't be very active in your bunker. It's not a very exciting diet, though, and it's still missing some vital nutrients. Add taste and nutrition at the same time with some simple additions.

Firstly, salt. The basic ingredients we've looked at so far contain little or no salt, and without salt you'll die. Aim for a quarter ounce of salt per person every day; that's enough to keep you healthy. This adds up to 1.5 pounds of salt over 90 days. Get iodized salt – that will help protect you against the radioactive iodine-131 found in fallout.

Canned or dried meat will add both protein and taste to your diet. It doesn't take much – an ounce a day will make a big difference. An ounce of Spam also contains another 80 calories, which is welcome. Of course, you won't be able to store opened cans without a fridge, so you may end up having larger quantities less often. A family of four could share a 12-ounce can of Spam every third day. Chop it up, fry it in some oil, then add water and rice and simmer it until the water is absorbed.

Dried or canned vegetables also add taste and calories. A 15-ounce can of corn will give you four 50-calorie servings, and if necessary it can be stored for a few days in Tupperware even at room temperature. Add 24 cans of vegetables (or an equivalent amount of dried) per person to give a three-month supply.

Finally, there are a load of small extras that will make a big difference. Teabags or instant coffee let you make hot, sweet drinks that will help maintain body temperature and give you a good way to consume sugar. Seasonings and sauces will make meals less boring – hot sauce is good, because a small amount goes a long way. Dried herbs, garlic powder, vinegar and tomato paste are all useful, too.

Don't waste water when cooking. You can't afford to cook pasta then throw the water away – but if you have some packets of instant soup mix you can use it to make those. You also won't be losing the calories from starch that's ended up in the water. That doesn't sound like a big deal, but after a couple of weeks on basic rations you'll appreciate every extra calorie you get.

Anything else you can add to your food stockpile will help; if you have time before retreating to the shelter, empty your kitchen cupboards, fridge and even the freezer, and take it all with you. Pack all the frozen food tightly in a bag and it will be usable for two or three days, at least – so eat that first, and help your survival rations last longer.

Medical supplies

You can't assume that everyone is going to make it to the shelter uninjured. Burns, cuts, fractures and even crush injuries are all likely after a nuclear attack, and if you're in a contaminated area it could be weeks before any medical help reaches you. You have to be able to do as much as you can yourself.

There are obviously limits to the medical treatment you can provide in a bunker, but with the right supplies you can cope with a surprising amount. First, get yourself a good first aid kit. The small type you'd find in a car is better than nothing, but not by a lot; they just don't have enough stuff in them.

You could be dealing with extensive burns or someone who's been cut by dozens of chunks of flying glass, so you need lots of basic supplies – Band-Aids, gauze, bandages and surgical tape. Adhesive sutures are handy, and don't forget a good supply of aspirin and Tylenol. The easiest way to get the quantities you'll need is to buy a workplace first aid kit – one rated for a 25-person workplace is good.

Anyone who's exposed to the flash from a nuclear weapon will probably have severe burns on any exposed skin; they'll lose a lot of fluids and be at risk of going into shock. If you can give blood expanders that will be a huge help, so get some sterile giving sets and a few bags of Hartmann's or Ringer's solution.

They're also valuable if anyone has severe bleeding, and in an emergency, you can use them as electrolyte drinks for anyone with diarrhea or vomiting (common symptoms of mild to moderate radiation sickness). They taste pretty terrible, but they will replace lost electrolytes and fluids.

It can be hard to get antibiotics without a prescription, but if you can get your hands on some put them in your bunker's first aid box. Anyone suffering from radiation sickness will be vulnerable to infections – and even an infected cut or burn could easily turn deadly.

Safety

Finally, make sure you can guard against emergencies in your bunker. After an attack or major disaster there are likely to be desperate gangs of looters who won't hesitate to attack you for your supplies. If you have weapons you'll be able to defend your bunker and its occupants.

Protective clothing is a great thing to have. Even when it's safe to start venturing outside, there will still be fallout around – and while its radioactivity will have decreased, you still don't want it on your skin or in your lungs. You also might have to go outside at an early stage to repair damage to the bunker, and then you'll need all the protection you can get. It's almost impossible to block gamma radiation with clothing, but keeping the fallout away from your body will make a huge difference.

Disposable painting coveralls and single-use plastic rain ponchos are cheap, compact and surprisingly effective. Take them off in the entrance tunnel and you'll keep the fallout safely away from your living space.

You should also store at least one full set of clothes – including shoes – for everyone who's going to be staying in the shelter. Look for lightweight, comfortable but warm clothes; sweats are fine. These are only for wearing in the bunker.

Don't forget fire. The last thing you want is to be faced with a choice between burning to death in your bunker or escaping into the fallout. Make sure you have the equipment to put out any fires caused by cooking or lighting failures. Fire blankets are good; they'll put out most fires without causing collateral damage. Foam extinguishers work well on oil fires. Avoid CO2 extinguishers; the gas is heavier than air and will be trapped in your bunker, turning it into a gas chamber. A single extinguisher is more than enough to asphyxiate everyone in a 250-square foot shelter.

It's up to you what else you store in your shelter, but with these basics you'll be able to survive. They cover all the fundamental requirements, and give you the resources you need to stay healthy enough to face whatever comes next. Without them, your bunker is just a well-protected hole in the ground; with them, it becomes a true survival refuge.

Chapter 12:

Surviving In The Bunker

As I said a couple of chapters back, I already tested the bunker by living in it for a week. That was fun, but to be honest it wasn't that hard a test. Any time I wanted to see the sky all I had to do was open the door and look out. Although I did stay in the bunker for the whole week, I always knew I was free to go outside any time I wanted.

Taking shelter for real is different. The bunker gives enough protection to keep you and your family alive, but that protection isn't granted by magic; you need to put some work in. Attention to detail is key – mistakes that seem small can have lethal consequences. In this chapter I'll tell you how to survive once you're in your bunker, no matter how hostile the world outside has become.

Most of the advice will be aimed at surviving a nuclear war, but it can easily be adapted to most other likely emergencies. If you're sheltering from a storm you don't need to worry about the advice on fallout – but if a local chemical plant has exploded, anti-fallout precautions will also protect you against that. Just tailor the advice to the emergency you're facing.

Immediate Action

If there's a nuclear attack, or a hurricane suddenly changes course and heads for your neighborhood, there's likely to be a lot of confusion and even panic. People will be frightened, and might not be acting very rationally. As soon as you're all in the shelter you need to bring that to an end.

Get everyone into the shelter, close the door, then tell everybody to stop anything they're doing and sit down. Check that everyone who should be there actually is there; if anyone's got lost or been overlooked you need to know that right now, so you can find them and bring them in before it becomes too dangerous. If an attack warning has gone out, weapons can start arriving just four minutes later; if the attack has already happened, the first fallout will be coming down very soon. There is no time to waste at this stage.

If fallout has started coming down by the time you reach the shelter, keep everyone as close to the entrance as you can. Don't let them move into the main bunker – they'll just carry radioactive dust with them, and you'll never get rid of it. Instead, get them to shake any dust from their hair and skin, then strip off, leave their clothes in the entrance tunnel, then go on into the shelter and change into the clothes you've stored there.

The contaminated clothes should be double-bagged in trash bags and kept in the tunnel; their radioactivity will decay over time, and eventually they'll be safe to wear again.

Once you know that everyone's there and uncontaminated, check the status of the shelter itself. Make sure the door is properly closed, the ventilation is working and there's no damage to the structure. Look for any signs that sandbags or roof beams have shifted. Tap the roof with a hammer to make sure the soil on top hasn't been swept off – boards with soil on top make a duller sound than exposed ones.

If you find any damage, and you'll need to go outside to repair it, get that done immediately. The longer you wait, the more dangerous it will become. If a nearby nuclear explosion has stripped away some of the soil, within ten minutes fallout will be landing on the exposed roof and pumping radiation into the shelter.

You need to get as much soil as possible back in place before it starts to come down, so get protective clothing on, get out there and fix it as fast as you can.

At an absolute minimum you need to get at least six inches of soil back in place. If fallout starts to descend before you've managed this, someone is going to have to risk radiation exposure to protect everyone else in the shelter. It's best if older or childless people do this. Once you have six inches in place, if fallout is already coming down get inside right away. If it hasn't started descending yet, keep working until it does.

The next priority is to check everyone for injuries. Even minor cuts need to be cleaned and covered as soon as possible, to reduce the risk of infection. If anyone has suffered serious burns, start rehydrating them as soon as possible; they'll lose a lot of fluids. Get any injured treated, medicated and put safely in bed to rest.

You need to check all your supplies as soon as possible – especially the water. Ground shock can have enough energy to split water containers, and you need to know about that right away. Leaking containers will let precious drinking water escape; the water can also ruin other supplies, and in extreme cases flood the shelter. Spending days or weeks in there with a couple of inches of water on the floor is not going to be pleasant.

Make an inventory of exactly what supplies you have. You probably have a pretty good idea of that anyway, but check again. If any food packaging has been damaged you'll need to either repackage it or use it right away.

Setting a routine

Once any emergencies have been dealt with, you need to establish a routine for life in the bunker. There are practical reasons for this, and it's also essential for morale. People will be frightened and apprehensive about the future, and pretty soon they'll be bored too. That's a perfect breeding ground for depression.

The best solution is to keep everyone occupied as well as you can. There will be jobs that need done, for a start. That won't be enough to keep people busy all day, but it will take up some time. Here are a few jobs that need done daily:

Check the bunker for damage or other issues – water from outside getting in, for example. This will be contaminated with fallout, so any leaks need to be fixed quickly.

Track food and water supplies. Check the inventory every day to make sure you're not getting through supplies faster than expected.

Make sure the toilet is maintained. Composting toilets are great, but you need to make sure there's enough sawdust in there to keep it composting properly. It's going to need emptied regularly, too.

General cleaning. Make sure any litter is picked up; it's a fire hazard and can attract vermin. Encourage people to keep things tidy.

Get everyone involved in meals, too. People can help with food preparation and washing up, but it's also a good idea to have regular meals for everyone. If people just help themselves to food when they feel like it that's inefficient, you can't make sure everyone's eating properly and it becomes easier for someone to withdraw into themselves and become depressed without anyone noticing.

Come up with ways to keep people involved. Card or board games are good – organize competitions or tournaments, and make sure everyone takes part. Hold regular discussions about how things are going, and ask for suggestions about improving life in the bunker. That will help people feel more in control.

Control food and water

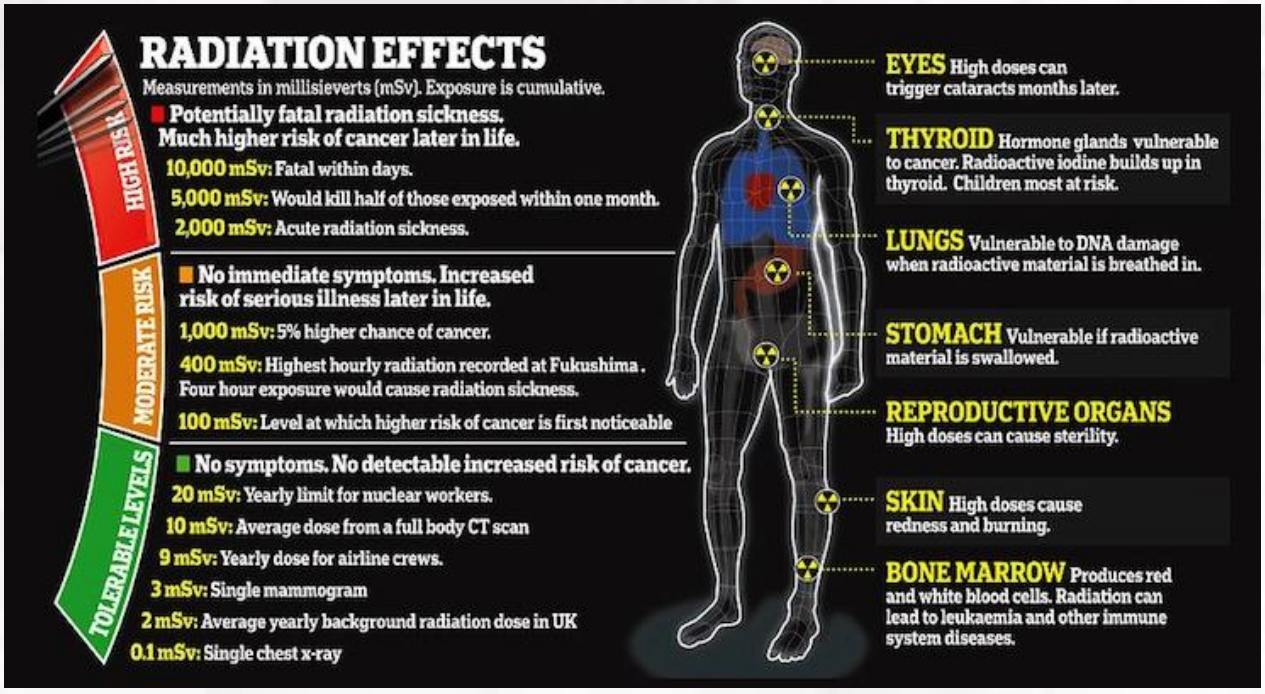
If your food supplies are going to last as long as you hoped, you need to strictly control what people are eating and drinking. Yes, everyone's likely to feel a bit hungry; you've stored survival-level rations. People are just going to have to get used to that. As soon as you give in to one demand for extra food, you'll just open the floodgates. The food supplies we looked at in the last chapter are enough to keep people alive and healthy; nobody needs more. But, if your supplies run out and it's still too dangerous to go outside, what then?

Water is even more important. Minimize the amount used for washing – hygiene is important, but has to be done efficiently. Only wash hands when necessary – before handing food and after going to the toilet. Body wash with a damp cloth instead of trying to improvise a shower or bath. Scrub plates and flatware in a box of sand before washing; this will reduce the amount of water you need.

Staying hydrated is important, but if you over-hydrate your body won't use the water efficiently. Only drink water when you're thirsty – if you don't feel thirsty, you don't need to drink. Give people their daily drinking water ration in a bottle, so they can drink when they need to.

Storing a sports bottle or military-style canteen for each person makes this easy. A one-quart canteen per day, plus a couple of hot drinks, is enough. Don't forget people will also be getting water from their food.

Control radiation exposure



Nuclear events might be survivable. Much depends on the type of event and your proximity to ground zero. Event possibilities range from dirty bombs that may distribute radiation over a small area, to nuclear accidents and nuclear weapon detonation that create large amounts of destruction and contamination. Your first goal is to avoid nuclear fallout, so you should take shelter immediately following a nuclear event. Then, you must mitigate the exposure that you do receive. Stay informed of local recommendations for your area, but be aware that your local news reporting may be designed to prevent mass panic, rather than give the best advice.

Harmful Effects of Radiation Exposure

The harmful effects of radiation exposure are many and varied. Some effects go unnoticed, only to cause cancers months or years later.

Before exposure and immediately after exposure, you should act quickly to prevent absorption and remove radioactive substances from the body. There are a number of supplements and compounds that can help you detoxify and prevent damage. Each acts differently and some, like Iodine, are specific to only one radioisotope, so plan to use all of these methods, or as many as possible, for best results.

The Law of Selective Uptake

One important principle in protecting the body from the absorption of nuclear isotopes is the law of selective uptake. Reduced to bare bones, it means that radioactive isotopes look like nutrients to the body, so if the body is deficient, it will grab hold of the isotope and use it in the body. You can prevent this absorption by taking extra doses of the nutrients.

Iodine supplements protect against iodine-131, cesium-137 mimics potassium in the body, strontium-90 mimics calcium, Plutonium-239 mimics iron, and cobalt-60 mimics vitamin B-12. Your first line of defense it to be nutritionally sound and take supplements for these minerals or vitamin when exposure is imminent or immediately following exposure.

If you have dosimeters, keep track of how much radiation each person has been exposed to. If anyone is starting to approach dangerous levels they need to be protected from any more exposure as much as possible.

We'll talk about these supplements in more detail below:

#1. Iodine

A nuclear or radiological event can release large amounts of Iodine-131 into the atmosphere. This radioactive iodine is quickly absorbed by the thyroid,

creating problems for the body immediately or even years later.

Researchers investigating the Chernobyl nuclear accident found that potassium Iodide reduced thyroid exposure to radiation with minimal side effects. Taking a dose of potassium Iodide or nascent iodine before the event or immediately after can fill the iodine receptors on the thyroid and prevent absorption of radioactive Iodine-131.

Nascent iodine is the most bioavailable form of iodine for this purpose, but potassium iodide (KI) is often recommended as well. One dose protects the body for 24 hours. If exposure is ongoing, daily doses will be needed, follow the recommendations of local authorities.

#2. Potassium

Potassium supplements protect the body from exposure to Cesium-137, another radioactive isotope that is commonly found in the environment following a nuclear event. Since cesium-137 mimics potassium in the body, immediate doses saturate the body with potassium and prevent absorption of cesium-137.

Rich potassium sources in the diet is a good first line of defense, but it may not be enough. Potassium Orotate is the best form of potassium supplements to use for radiation exposure. Follow dosing guidelines on the product you choose, since too much potassium can have ill effects.

#3. Calcium and Magnesium

Calcium and magnesium protect the body from absorbing Strontium-90. Supplementing with these nutrients has been proven to reduce strontium-90 absorption by up to 90 percent.

As mentioned earlier strontium-90 mimics calcium, but these two minerals work together and need to be balanced, so for best results take daily supplements of both of these minerals.

#4. Iron

Some women take iron on a regular basis, but most men do not need regular supplementation. However, in a nuclear event, iron supplements can prevent the uptake of Plutonium-239. Take a daily iron supplement during exposure, but consult a physician about long term use.

#5. Vitamin B-12

A fast absorbing vitamin B-12 supplement, such as Methylcobalamin can protect the body from exposure to cobalt-60. Cobalt-60 is a product of nuclear reactors, so exposure could come from an accident at a nuclear reactor. It is also used in radiation therapy and could come from a spill or a dirty bomb. Take vitamin B-12 daily, following the label recommendations.

#6. Dimethylsulfoxide (DMSO)

Dimethylsulfoxide (DMSO) is a controversial sulfur compound that has been shown to actively detoxify the body and protect against the harmful effects of radiation. Animal studies show that DMSO protects DNA from breakage due to radiation exposure and guards against cell destruction. A Japanese study showed that even low doses of DMSO provide protection against radiation damage at a cellular level and can facilitate DNA repair.

More research into DMSO is needed, but so far the results are promising. The FDA has not approved it's use except for preservation of transplant organs and for cases of interstitial cystitis. If you choose to use DMSO, look for pure sources containing no other solvents, except possibly a small amount of water.

#7. Zeolite Clay

Zeolites clean the body of toxins and radioactive particles in the same way they clean the environment. Their porous structure and affinity for positive ions allow them to bind toxins and nuclear waste to them and remove them as they passthrough the body.

Zeolite Clay can be safely taken internally and was widely used for detoxification at Chernobyl. In addition to detoxifying the body, it is useful in removing nuclear contamination from the environment and can be used to mop floors and clean walls in contaminated areas.

#8. Other Clays

Bentonite, Fuller's Earth, Kaolin, red clay, French Green Clay, and other clays are also effective at binding nuclear waste and removing it from the body. Clay particles are negatively charged, so positively charged radioactive ions are attracted to them.

They can be taken internally or used to scrub down the body to remove external contamination. Clays are considered safe to consume, but be sure to purchase a pure, food grade clay.

#9. Activated Charcoal

Activated charcoal is useful for absorbing and neutralizing a number of poisons and toxins, including radiation. Studies show that activated charcoal is able to neutralize up to 70 percent of its weight in radioactive toxins.

Other uses for activated charcoal include: natural remedy for dental infections, kidneys infections, ear infections, lowers blood pressures, water purifier and many more.

#10. Papain

Papain is a natural enzyme found in papaya fruit and known for its ability to reduce toxins. Studies in mice show that it helps exposed mice survive lethal radiation doses.
Early research suggests that papain reduces skin reactions and other side effects following radiation therapy.

#11. Bee Pollen

Recent studies suggest that bee pollen is effective in preventing and relieving the negative effects of radiation therapies by boosting the body's defenses and supporting natural functions and it could provide these same benefits after a nuclear event.

#12. Beets

Beets are excellent sources of antioxidants, which can help protect the body from the stresses of radiation exposure. They also help the body rebuild hemoglobin broken down as a result of exposure. Animal studies show that rats eating a diet heavy in beets had less effects after exposure to cesium-137. They were able to absorb and detoxify up to twice the radiation dose of the control group.

#13. Cold-pressed Organic Vegetable Oils

Olive oil, coconut oil, sesame oil and other healthy oils offer some protection during and after radiation exposure. Lipids in the oils offer protection to individual cells, lining the cell membrane and binding toxins before they can cause cell damage.
Animal studies show that mice fed oil are protected from doses of x-rays ranging from 300 to 2,400 roentgens and can survive lethal doses. The recommendation is to drink ½ cup of oil as soon as possible after exposure.

#14. Organic Germanium-132

Organic Germanium-132 is an ultra-modern mineral that increases oxygenation of the cells, supports the immune system and helps the body get rid of toxins, including radiation.
Recent studies in the US and Japan have been experimenting with doses of 500 to 1000 mg per day for various medical conditions, but current recommendations in Japan are that exposed individuals take 100 mg daily of Organic Germanium-132.

It is important to note that only organic germanium is recommended here. Inorganic germanium is highly toxic. In minerals, the term organic has a different meaning than in food and inorganic germanium is a completely different compound.

#15. Prussian Blue

Prussian Blue, also known as ferric ferrocyanide, is useful as an antidote for Cesium-137 when the radioactive isotope has been ingested. In the Brazilian Goiânia incident, researchers found that treatment with up to 10 grams of Prussian Blue daily removed up to 70 percent of the Cesium-137 from the body and reduced it's effects accordingly. This is an experimental antidote for use only in cases of known exposure to cesium-137.

#16. Organic Brewers Yeast

Some sources recommend organic Brewers yeast for preventing the effects of radiation and helping the body repair after exposure. Give 5 to 15 mg to children and 25 to 50 mg to adults. For cases of known exposure, this dose can be safely doubled or even tripled.

Other Recommendations

During and following a nuclear event, nutrition and general health are vitally important. Eating fruits and vegetables containing high amounts of antioxidants will help protect the body from the harmful effects of radiation. Obviously, do not consume plants that have been exposed to fallout or grown in contaminated soil, but frozen, dried, freeze-dried and safe fresh produce are healthy and give the body systems a boost.

For best results, each of these remedies should be begun immediately upon a nuclear event or exposure. Preparation is key. You should have these ingredients on hand before an event along with instructions on how to use them.

Finally, the Easy Cellar was designed to protect against fallout. As long as the bunker is intact it will keep contamination out of the living space and block most of the radiation from outside. Just remember that the maximum protection is below ground level, so when people have nothing else to do they're safer sitting or lying down. That can reduce residual exposure by 50% or more.

Do everything you can to keep the main shelter free of fallout, especially if anyone is going outside for any reason. A curtain (or, even better, a door) at the inner end of the entrance corridor will help keep dust out of the shelter, and it's also effective as a psychological barrier – it makes clear that the main bunker and the tunnel are separate spaces. One is safe to be in, and the other is not. In practice the tunnel is relatively safe, but discourage people from going into it if they don't need to.

Any protective clothing that's been worn outside should stay in the tunnel – never bring it into the main shelter. Bagging it will reduce the amount of stray fallout floating around the tunnel, too. Any cleaning of fallout from hair and skin should be done in the tunnel, and cloths, towels or brushes you use for it should stay there too. In fact, that's the basic rule that will protect you all from radiation; if it's been exposed to fallout, it stays in the tunnel. It's almost inevitable that small amounts of fallout will get inside, but by being careful you can keep that down to relatively harmless levels.

Sometimes you're going to have to be coldly pragmatic about radiation. If someone has taken a very high dose for some reason – they were late getting to the shelter, for example, and were caught outside in highly radioactive fallout – there isn't anything you can do for them.

Anyone who's suffered a total dose higher than 500 rads has less than a 10% chance of survival without advanced medical care, falling to 0% at about 800 rads, but they'll be able to stay active for anything from a few hours to a week or two. If work needs doing outside, use them to do it.

This sounds brutal, especially when it's a loved one, but the reality has to be faced. At this point it doesn't matter if they take more radiation, so why let someone who does have a chance of survival take it instead?

This all sounds a bit grim, but overall things are pretty positive. If you're in a well-built Easy Cellar, with enough supplies, your chances of surviving anything up to and including a full-scale nuclear war are high. You just need to take some simple precautions, use your supplies wisely and keep on top of routine cleaning and maintenance.

So now I have a shelter which will save my family if World War Three arrives – and, looking at the news these days, it doesn't feel like it's very far off. Even if we're lucky enough to avoid a nuclear attack, though, it's still a useful thing to have. Just think; if a tornado comes along, how grateful would you be for a secure place to take cover. And, while we wait to see what kind of disaster the world is going to throw at us next, we have somewhere to store our potatoes!