

Should we Build a Fallout Shelter?

Contents: A role-play exercise concerning the building of a nuclear fallout shelter.

Time: 2 periods. Homework time could be used for preparation.

Intended use: GCSE Physics and Integrated Science. Links with work on radiation.

Aims:

- To complement prior work on characteristics of radiation and the shielding effect of different materials
- To develop awareness of the likely effects, both immediate and long term, of a nuclear explosion
- To develop awareness of certain issues relating to civil defence and the survival of a nuclear attack
- To provide an opportunity to practise skills in debate and communication of information and arguments.

Requirements: For each member of the class: copies of the General Briefing sheets. In addition, two copies of each of the Specific Briefing sheets B1, B2, B3, B4 and B5 will be needed.

Organization of the activity

Most members of the class will assume the role of members of Eastborough Council, meeting to decide whether a nuclear fallout shelter should be built. In addition, there are the following special roles:

Mayor/Mayoress of Eastborough
 Brigadier A, Commander of the local army unit
 Doctor B, the Borough Medical Officer
 Ms/Mr C, the Borough Engineer
 Ms/Mr D, the Coordinator of Emergency Services for Eastborough.

The Mayor/Mayoress will run the meeting, and should be chosen for appropriate personal qualities. Preferably the role should be played by a student, but if necessary the teacher could do it.

It is recommended that each of the other roles be taken by **pairs** of students, working together to prepare the role and answer the questions.

Suggested procedure

- 1 Allow 15 minutes or so for students to study their briefings. Some of this preparation could be done before the lesson, using homework time. They should all read the General Briefing first. Those in special roles should then read their Specific Briefings. Meanwhile, the remainder of the class (the councillors) can be preparing the questions they wish to ask at the meeting.
- 2 Bring the class together for the meeting, with seating arranged appropriately. The rest of the proceedings are handled by the Mayor/Mayoress, following the outline on Briefing Sheet B1.

Further resources

Nuclear Issues in Education: a Teaching Guide is a comprehensive teaching pack compiled by a working group of the Newcastle-upon-Tyne Education Committee. Available from: Pendower Hall Educational Development Centre, West Road, Newcastle-upon-Tyne NE15 6PP.

The Nuclear Issue: a Source Book for Education, by J. J. Wellington (Blackwell) includes a range of teachers' and students' materials.

SHOULD WE BUILD A FALLOUT SHELTER?

General Briefing

In this activity you will be taking part in an imaginary meeting of Eastborough Borough Council. The purpose of the meeting is to decide whether the Council should build a nuclear fallout shelter, in case of nuclear attack.

The map in Figure 1 shows the Eastborough district (population 30 000).

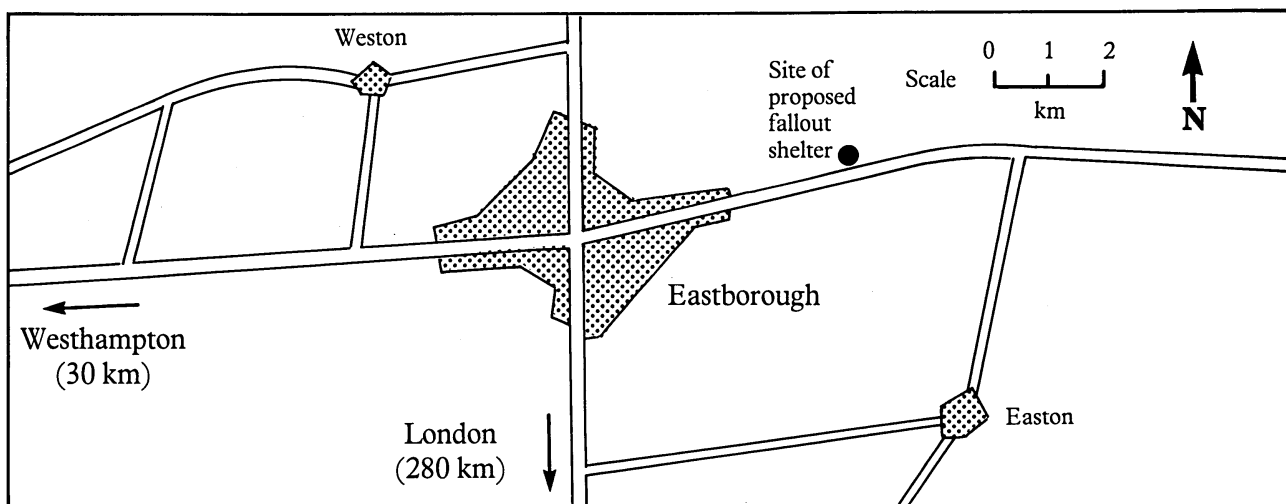


Figure 1 Map showing the Eastborough district

After a nuclear attack, Council workers would try to organize help for the survivors. The purpose of the Council fallout shelter would be to protect these organizers.

Roles

Most students will be playing the parts of councillors, but there are also some special roles:

The Mayor/Mayoress of Eastborough. This person will run the meeting. He or she will call expert witnesses in turn. Each witness will be questioned by members of the Council for a limited time. It will be necessary for councillors to decide beforehand who will ask questions on particular points. The Mayor/Mayoress will then allow a short general discussion, before taking a vote on the proposal.

The expert witnesses:

Brigadier A, Commander of the local army unit, will answer questions on the likely effects on Eastborough of a nuclear bomb explosion. This might be locally, or at Westhampton 30 km away.

Doctor B, the Borough Medical Officer, will answer questions on the medical effects on human beings of nuclear explosions and radioactive fallout.

Ms/Mr C, the Borough Engineer, will answer questions on the ability of different materials to give protection in a nuclear attack, and the equipment needed in the shelter.

Ms/Mr D, the Coordinator of Emergency Services for Eastborough, will answer questions on the effect of a nuclear attack on the work of the emergency services.

The proposal

The Proposal before this meeting of Eastborough Borough Council is that the Council should approve the building of a nuclear fallout shelter, in order to safeguard communications with emergency services after a nuclear attack.

The arguments for and against building the shelter can be summed up as follows.

FOR	AGAINST
<p>It is our duty to save lives wherever possible</p> <p>Many people who were not killed by a nuclear explosion would die from radiation sickness afterwards if there were no Civil Defence preparations.</p> <p>If they have enough information, survivors can organize in groups and make plans for long-term survival.</p> <p>Survivors can best be helped if there are people to organize the rescue services and repair teams. These people would have to be protected by a shelter.</p>	<p>After a nuclear war, conditions would be so bad it would not be worth surviving anyway.</p> <p>A country which has taken Civil Defence precautions will not be so worried about becoming involved in a nuclear war.</p> <p>Suggesting that people could survive a nuclear war will make them less ready to protest against nuclear weapons.</p> <p>It is immoral for those in power to be protected, if there are only enough shelters for very few people.</p>

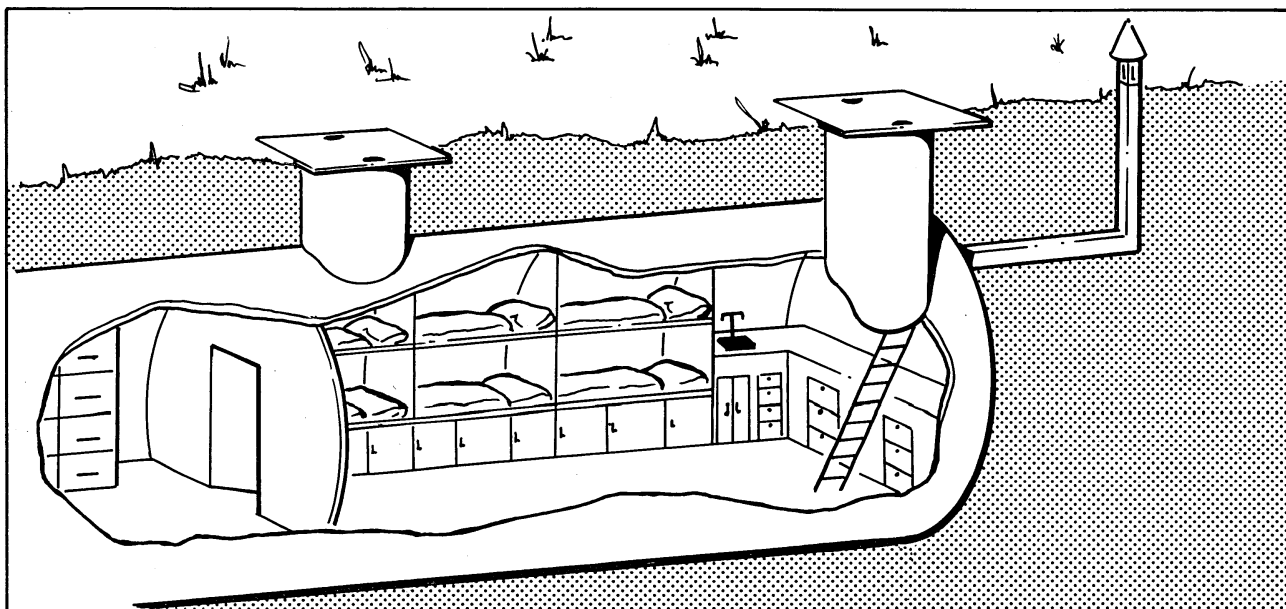


Figure 2 Part of a fallout shelter, made of steel and concrete and buried underground

Briefing Sheet 1

The Mayor/Mayoress of Eastborough

First make sure that you have read the General Briefing, then you can concentrate on your part in the proceedings.

Much of the success of this activity depends on you. Remember that *you are in charge*. Insist upon being addressed as Mr Mayor or Madam Mayor. Make sure that nobody speaks until you ask them to. You must not give your own opinion. Make sure that an equal chance is given to those For and Against the proposal. In private life you run your own business. You are a down-to-earth person, more interested in facts than fancies.

Here is what you should do when the meeting starts.

- 1 Call the meeting to order and read out the Proposal from your General Briefing Sheet.
- 2 Announce the order in which you will be calling the expert witnesses: first Brigadier A, then Dr B, Ms/Mr C, Ms/Mr D.
- 3 Before calling any witnesses, you should ask for questions. First, ask which councillors would like to question Brigadier A. Ask for the subjects of their questions. If there are too many (say, more than four) you will have to choose the most relevant. If a really important point seems to have been missed, you may remind them of it.

Do the same with respect to questions for the other witnesses.

- 4 Call your first witness. Introduce him or her to the Council and ask for the first question. If the answer is not perfectly clear, the questioner may ask a follow-up question. Otherwise, pass on to the next question.

After all the questions to this witness, ask if the witness wishes to make a statement about any important point not covered. Then thank the witness and ask him or her to stand down.

- 5 Deal with the other witnesses in a similar way.
- 6 Announce that the Proposal is open for discussion. Any councillor in favour may state his or her reasons. Then any councillor who is against it may do likewise. Then, depending upon time available, take others in turn. Do not allow interruptions.
- 7 When the general discussion seems to have gone far enough, read out the Proposal again and ask for votes. First take votes For, then Against. Finally announce the result.

Briefing Sheet 2

Brigadier A, Commanding Officer of an army unit based on Eastborough

You may be asked questions about the probable effects of nuclear explosions. Carefully study the following information, which you may quote in your answers.

The atom bomb exploded over Hiroshima in 1945 had a power of about 15 kilotons. This is the same as 15 000 tons of TNT.

A modern nuclear weapon might have the power of 1 megaton — 1 million tons of TNT. If exploded high over Eastborough it would have these effects:

- A brilliant *flash of light* lasting for about a tenth of a second.
- *Radiation* of neutrons and gamma rays. This would last about ten seconds and travel about 2.5 km from the explosion.
- A *fireball* producing intense heat. It would be enough to make trees catch fire about 10 km away and cause *winds* of hurricane force.
- A *blast wave*, which would destroy buildings up to 3 km away and form a crater 30 metres deep.
- An *electromagnetic pulse*, which could travel through aerials and telephone wires to destroy unprotected electronic equipment.

A nuclear explosion nearer ground level (a 'ground burst') would also suck up earth and turn it into a cloud of radioactive dust. This would drift down-wind and gradually fall as **radioactive fallout**. A 'ground-burst' on Westhampton, 30 km away, could cause fallout on Eastborough. The fallout would occur an hour or more later, depending on wind speed and direction.

Fallout would settle as dust and give out harmful radiation. The strength of this radiation would decrease rapidly. It would become a tenth as strong after 7 hours and a hundredth after 2 days. The time for the radiation to decrease to a safe level would probably be measured in weeks. Military and civil-defence workers have instruments which can measure the strength of radiation from fallout.

Radiation kills living cells, but it cannot make other things radioactive. The radioactivity stays with the dust on ground or rooftops, unless it is washed off by rain or blown away by the wind. It is particularly dangerous if the dust is breathed in or eaten.

When weapons of different sizes are compared, it is important to remember that a lot of the energy from an explosion goes upwards. A 1000 times more powerful bomb affects an area only 100 times greater.

Briefing Sheet 3

Doctor B, Medical Officer for Eastborough

You may be asked questions about the effects on humans of the results of a nuclear explosion. Carefully study the following information, which you may quote in your answers.

The atom bomb exploded over Hiroshima in 1945 had a power of about 15 kilotons, the same as 15 000 tons of TNT.

A modern nuclear weapon might have the power of 1 megaton — 1 million tons of TNT.

It is impossible to make accurate estimates of casualties from a nuclear explosion. Up to 5 km from the Hiroshima bomb 68 000 were killed and 76 000 injured out of a population of 256 000. A reasonable guess for a 1 megaton explosion is that about half the people within a 3 km radius would be killed. In the case of Eastborough, this would mean 15 000 would be killed.

Many people within a few kilometres of the explosion would be killed by the heat or blast effects. Unprotected survivors could be injured by flying debris, or badly burnt or temporarily blinded by the flash.

Survivors might also suffer from **radiation sickness**. This would be caused either by being near the explosion or by being near to radioactive fallout. The effect would depend on the strength of radiation and how long they were exposed to it. A large 'dose' may be fatal. A smaller dose would cause unpleasant symptoms, like a combination of flu and food-poisoning. A very small dose may seem to have no immediate effects. However, it may possibly cause illness such as cancer many years later. None of these effects is 'catching' — they cannot be passed on from one person to another. Scientists are unsure how much the children of survivors are affected by their parents having been exposed to radiation.

Many scientists believe that the long-term effects of a major nuclear war would make survival worthless anyway. Law and order would break down, and there would be chaos throughout the country. After a major nuclear war, clouds of dust would fill the sky, cutting out much of the Sun's heat and light. This might result in several months of very cold 'nuclear winter', making survival even more difficult.

Briefing Sheet 4**Ms/Mr C, Borough Engineer of Eastborough**

You may be asked questions about the way building materials can protect against the effects of a nuclear attack, and the equipment needed in the shelter. Carefully study the following information, which you may quote in your answers.

The atom bomb exploded over Hiroshima in 1945 had a power of about 15 kilotons, the same as 15 000 tons of TNT.

A modern nuclear weapon might have the power of 1 megaton — 1 million tons of TNT.

The main job of a fallout shelter is to provide protection against the radiation given off by fallout. Fallout gives off three kinds of radiation: alpha, beta and gamma. Alpha and beta radiation can easily be stopped by an ordinary building, but the dust carrying them would be very dangerous if breathed in. Fallout shelters therefore need a filtered air supply. Gamma radiation is much more penetrating. A depth of at least three feet of earth or two feet of concrete is needed to stop it. An ordinary cellar could be adapted to make a fallout shelter.

At one kilometre or less from a 1 megaton nuclear explosion the blast would be extremely powerful. Only a very deep and expensive shelter would give protection. But 4 or 5 kilometres away, three feet of earth would be enough to resist both blast and radiation.

It is important to realize how much equipment a shelter would need, even for a few people. They would probably have to stay there until the radiation had reduced to one-thousandth of its original strength. This would take several days, possibly as long as two weeks. During this time the air pump would have to be kept going, driven by batteries or even by hand.

The people inside the shelter would need:

- Water supplies. Fallout would not contaminate water so long as dust did not settle on it. However, water mains would probably be broken, so canned supplies would be needed.
- Food Supplies. Any food in unbroken containers, from which any fallout dust was washed off, would be safe to eat.
- Lighting, heating, toilet facilities, etc.
- Communications, rescue and first-aid equipment.
- Protective clothing and radiation measuring equipment.

Briefing Sheet 5**Ms/Mr D, Coordinator of Emergency Services in Eastborough**

You may be asked questions about the effect of a nuclear attack on communications with emergency services. Carefully study the following information, which you may quote in your answers.

Each of the emergency services (fire, police, ambulance and engineers) has their own building. Part of each building has been designed to protect them and their equipment in a nuclear attack.

After a nuclear attack, Council workers would have to organize when and where the various emergency services would be sent. The Council's fallout shelter would be to protect these workers.

Radiation-measuring instruments would be used to see how much radiation there was in Eastborough after the attack. If radiation was high, the emergency services would have to wait for it to fall before trying to help people in Eastborough. But it is thought that even in a severe nuclear attack about one-fifth of the country would probably receive no radiation. If the instruments showed little or no radiation in Eastborough itself, the emergency services would be able to start work immediately. They could help nearby areas which were not so fortunate.

The emergency workers would have to wear protective suits and rubber boots, so that fallout dust could be washed off. They would also have to carry personal 'radiation dosimeters'. These would tell them when the total dose of radiation they had received was nearing the danger limit. They would then need to take shelter and be replaced by new workers.

The Council fallout shelter would need the following:

- A local leader, with the knowledge and authority to decide what actions should be taken.
- A scientific adviser with maps and instruments, to use information to forecast local conditions in the Eastborough area.
- Communications equipment, protected from the various effects of a nuclear explosion. There would also need to be a person to receive messages about damage, weather conditions and radiation levels in different parts of the country. A network is already set up to report this information.
- Supplies for these people to keep working for several weeks, such as water, food, lighting and toilet facilities.