What happened in Chernobyl?

On April 26, 1986, the world's worst nuclear accident happened at the Chernobyl plant near Pripyat, Ukraine, in the Soviet Union. A massive power surge attributable to poor design and mismanagement led to a series of explosions inside the fourth reactor at the Chernobyl nuclear power plant, in Pripyat, Ukraine. The blasts managed to eviscerate the 2,000-tonne upper plate of the reactor and destroy its core.

According to the Organisation for Economic Co-operation and Development's Nuclear Energy Agency, the two explosions produced a shower of hot and highly radioactive debris. The resulting plume of radioactive smoke rose about one kilometre into the air and began to make its way across Europe. The World Nuclear Association says that during those 10 days, the world experienced the largest uncontrolled radioactive release in human history. The town was quickly evacuated but more than 30 years after the world's worst nuclear accident, experts still can't agree how many people it killed. The long-term impact of the radiation has proved impossible to quantify. Three decades ago, John Gittus of the Royal Academy of Engineering told the UK government there could eventually be around 10,000 fatalities. Today, some – notably environmental groups – put the death toll well into six figures.

But how did it all happen?

On April 26, 1986, the Chernobyl operating crew was planning to test whether the turbines could produce sufficient energy to keep the coolant pumps running in the event of a loss of power until the emergency diesel generator was activated. To prevent any interruptions to the power of the reactor, the safety systems were deliberately switched off. To conduct the test, the reactor had to be powered down to 25 percent of its capacity. This procedure did not go according to plan and the reactor power level fell to less than 1 percent. The power therefore had to be slowly increased. But 30 seconds after the start of the test, there was an unexpected power surge. The reactor's emergency shutdown (which should have halted a chain reaction) failed.

The reactor's fuel elements ruptured and there was a violent explosion. The 1000-tonne sealing cap on the reactor building was blown off. At temperatures of over 2000°C, the fuel rods melted. The graphite covering of the reactor then ignited. The graphite burned for nine days, churning huge quantities of radiation into the environment. The accident released more radiation than the deliberate dropping of a nuclear bomb on Hiroshima, Japan in August 1945.

The clean up

Initial attempts to extinguish the burning reactor involved fire fighters pouring cooling water into the reactor, but were abandoned after 10 hours. From 27 April to 5 May, more than 30 military helicopters flew over the burning reactor. They dropped 2400 tonnes of lead and 1800 tonnes of sand to try to smother the fire and absorb the radiation. These efforts were also unsuccessful. In fact they made the situation worse: heat accumulated beneath the dumped materials. The temperature in the reactor rose again, along with the quantity of radiation emerging from it. In the final phase of firefighting, the core of the reactor was cooled with nitrogen. The fire and the radioactive emissions were finally under control on May 6.

Despite the obvious dangers the response to the disaster needed people. Not just a few, but thousands of people whose lives and health were sacrificed in vain attempts to contain the disaster. These people were termed 'liquidators'. The 600 men of the plant's fire service and the operating crew were the most severely irradiated group. In this group 130 men were irradiated with doses equivalent to 650 years' worth of a radiation worker's annual limit. Thousands of military personnel and other workers were drafted in to move deadly radioactive material with little or no protection. As a result of the severe exposure to deadly radiation, 31 of those workers died shortly after the fire was put out. A total of between 600,000 and 800,000 men were involved in the clean-up operations in Chernobyl up to 1989. Of these men, 300,000 received radiation doses 500 times the limit for the public over one year. Today, the ones who survive are still suffering from the irreversible damage to their health.

How many of them have died to date from the disaster is a controversial question. According to government agencies in the three former Soviet States affected, about 25,000 "liquidators" have so far died. Estimates provided by the liquidator associations in the three countries are well in excess of the official figures. These discrepancies in numbers are due to

different methods of assessment. Also the liquidator statistics (number of casualties and amount of radiation received) were distorted by the Soviet authorities so definitive numbers may never be known.

A sarcophagus puts an end to the disaster?

Following the explosion, a massive concrete 'sarcophagus' (cover) was constructed around the damaged no. 4 Reactor. This sarcophagus encased the damaged nuclear reactor and was designed to halt the release of further radiation into the atmosphere. The first task in containing the destroyed reactor was to build a 'cooling slab' under the reactor to prevent the still-hot reactor fuel from burning a hole in the base of the reactor. Coal miners were drafted in to dig this tunnel under the reactor and by 24 June four hundred coal miners had built a 168m long tunnel under the reactor.

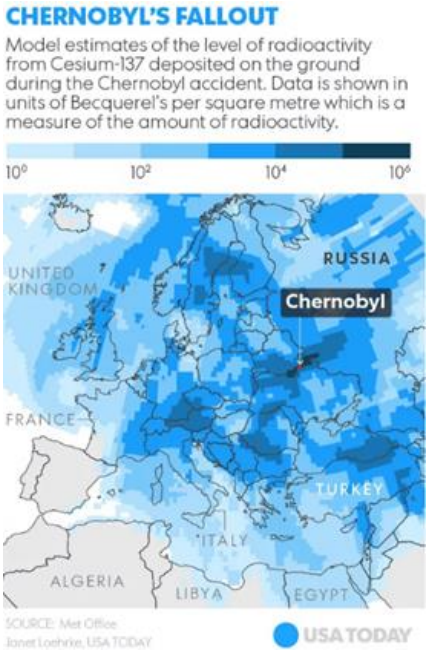
By November 1986 the sarcophagus containing the reactor was completed using more than 7,000 tonnes of steel and 410,000m3 of concrete. The sarcophagus was designed with a lifetime of only 20 to 30 years in mind. The greatest problem however, was a lack of stability. The sarcophagus was hastily constructed, and the corrosion of supporting beams continues to threaten the integrity of the entire structure. Water is leaking through the sarcophagus via holes in its roof, becomes radioactively contaminated, then seeps through the floor of the reactor into the soil below.

Scientists predict that the next nuclear catastrophe in the scale of Chernobyl will be in Chernobyl itself, due to the fragile status of its protective shield. There is no certainty as to how much fuel has been left inside the reactor but most estimates put it at more than 95 percent of its original contents. Also dumped inside the sarcophagus are thousands of cubic metres of nuclear waste created by fragments of the destroyed reactor building and contaminated soil that has also been dumped into the sarcophagus.

2065 Death Toll

The Chernobyl accident resulted in a large release of radionuclides, which were deposited over a very wide area, particularly in Europe. Although an increased risk of thyroid cancer in exposed children has been clearly demonstrated in the most contaminated regions, the impact of the accident on the risk of other cancers as well as elsewhere in Europe is less clear.

There is a lot of confusion about how many excess cancer deaths will likely result from the 1986 Chernobyl accident in Ukraine and its neighbouring countries. There are two main sources of confusion: information that is confusing—and in some cases misleading—put out by authoritative sources, and large inherent uncertainties in estimates of the effects of the accident. Because of these inherent uncertainties, it is perhaps most appropriate to only cite order-of-magnitude results: the numbers of excess cancers and cancer deaths worldwide will be in the tens of thousands.



Environmental physicist Jim Smith of the University of Portsmouth, UK, prefers to cite a 2006 study by Elisabeth Cardis of the International Agency for Research on Cancer in Lyon, France. This predicted that by 2065 Chernobyl will have caused about 16,000 cases of thyroid cancer and 25,000 cases of other cancers, eventually leading to a total death toll of between 30,000 and 60,000 people.

In Russia, where much information about Chernobyl remains classified, the health ministry said more than 900,000 people undergo annual medical examinations associated with the nuclear accident, including 240,000 children. Nadiya Gudz, a doctor at Ukraine's largest Chernobyl-related medical clinic outside Kiev, said the accident's second generation — the children of those who were youngsters in 1986 — now suffer the most. She said they have digestive disorders, birth defects, genetic abnormalities, respiratory problems, cancer and other conditions.

Exercise1: Mark the following statements as True or False according to the text:

	True	False
1. On April 26, 1986, the world's worst nuclear accident happened at the Chernobyl plant.		
2. A massive power surge led to a series of explosions inside the fifth reactor.		
3. The two explosions produced a shower of hot and highly radioactive debris.		
4. The locals refused to abandon their houses after the explosion.		
5. The long-term impact of the radiation has proved impossible to quantify.		
6. 30 seconds after the start of the test, there was an unexpected power surge.		
7. The 1000-tonne sealing cap on the reactor building was blown off.		
8. Initial attempts to extinguish the burning reactor failed.		
9. From 27 April to 5 May, more than 30 military drones flew over the burning reactor.		
10. In the final phase of firefighting, the core of the reactor was cooled with nitrogen.		
11. A massive concrete 'sarcophagus' (cover) was constructed around the damaged no. 4 Reactor.		
12. Scientist estimate that about 50% of the original fuel still remains in the reactor.		
13. The Chernobyl accident resulted in a large release of radionuclides.		
14. There is an increased risk of thyroid cancer in children exposed to radiation.		
15. In France, about 900,000 people have conducted some kind of cancer because of Chernobyl.		

Exercise 2: Match the words to their definitions:

○ attempts	1. to flow through fine pores or small openings
○ classified	2. a stone coffin / tomb
○ contaminated	3. an unimpaired condition
○ deliberate	4. deaths, casualties
○ distorted	5. efforts
○ extinguish	6. huge, enormous
○ fatalities	7. infected, polluted, corrupted
○ fragments	8. measure the quantity
○ integrity	9. on purpose
○ massive	10. pieces, parts broken off
○ prevent	11. put out
○ quantify	12. to keep from happening
○ sarcophagus	13. to kill by depriving of air
○ seeps	14. twisted
○ smother	15. withheld from general circulation for reasons of national security

Exercise 3: Answer the following questions in class

1. What's your opinion on using nuclear energy?
2. Are there any benefits to the use of nuclear energy?
3. What are the disadvantages of nuclear energy?
4. Do you think that nuclear power plants are inherently unstable?
5. Do you think that nuclear power stations could literally "blow up" like a nuclear bomb?
6. What options do we have for dealing with nuclear waste?
7. Which do you think more dangerous to human life over the next two hundred years - nuclear pollution or carbon dioxide/global warming?
8. Would you live next to a nuclear power plant?
9. Could nuclear energy help the third world to develop carbon-free economies?
10. What percentage of the world's energy could be obtained from renewable sources?
11. Does nuclear power lead inevitably to nuclear weapons?
12. Can some countries be "trusted" with nuclear weapons and others not?
13. What would be the consequences of a nuclear war?
14. If a country has nuclear weapons do you think it is more likely to be attacked or less likely to be attacked?
15. Is there any difference between "radiation" and "nuclear radiation" - what is it?
16. What can exposure to nuclear radiation do to the human body?
17. Is nuclear radiation linked to cancer?
18. Is nuclear radiation linked to infertility?

Exercise 4: Fill in the gaps using the words given :

benefits, boiling, civilized, committee, compensated, dismantled, eligible, evacuated, explosion, healthcare, liquidators, meltdown, payments, radiation, repeatedly, sanatoriums, sarcophagus, spell, test, worker

Chernobyl Victims Struggle With The Consequences of Radiation Exposure

When the first 1._____ tore through the Chernobyl nuclear plant, at 1:23 a.m. on April 26, 1986, engineer Pyotr Palamarchuk was spun around by a shock wave. The second blast deafened him. Ceiling panels crashed to the floor, and the halls were filled with radioactive vapour. Nearby he found a co-2._____, Vladimir Shashenok, who had been doused in 3._____water and radioactive steam from burst pipes. Palamarchuk carried him out and was burned on his back and arms where their bodies touched.

In the accident, the 1,000-ton lid of Reactor No. 4 was blown off after heat built up during a safety 4._____. Nearby towns were 5._____, and radioactive material blew across Europe. Over the next four years, around 600,000 so-called 6._____—the catch-all term for the engineers, soldiers, medics, and others who dealt with the catastrophe—worked at the site.

And today he complains that he and others injured in the accident and subsequent clean-up, when emergency workers entombed the reactor in a concrete 7. _____, must battle for benefits from the Russian government. They have already been stripped of many, notably the right to free 8._____. "In spite of all that we suffered, the health we sacrificed, the government doesn't deal with us with enough understanding," says Palamarchuk, who has formed a lobbying organization, Our Right.

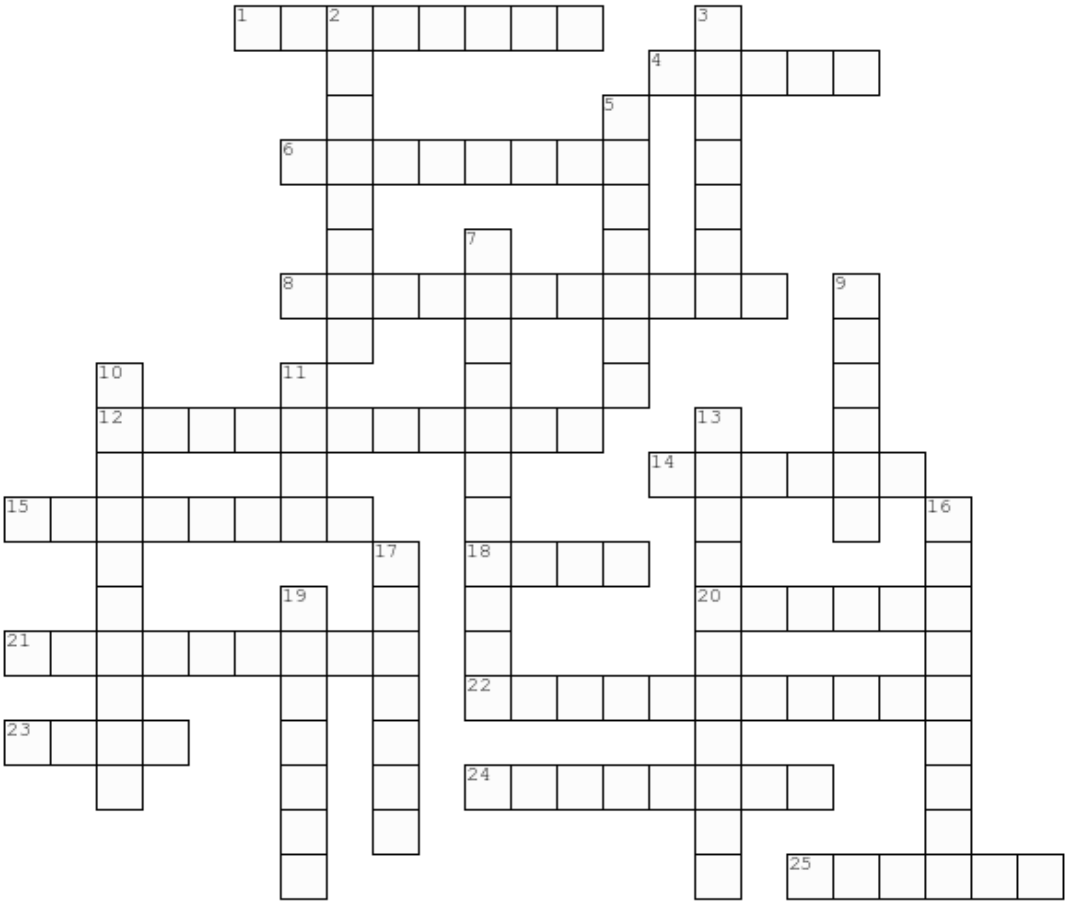
Initially, a 1991 Soviet law generously 9._____professionals—engineers, nuclear specialists, medics—with housing, cars, and monthly payments. In 1993, with growing numbers of people claiming 10._____, the Russian government published a list of diseases considered linked to the accident, and for which a sufferer was 11. _____for free treatment. A 2004 law, which sparked hunger strikes and protests by liquidators across the country, monetized benefits such as free healthcare—but liquidators complained that the 12._____were far too small. Some benefits were also ended, such as assistance in buying cars, free transport to and from hospitals, and free treatment at 13._____.

Lawmakers admit that Chernobyl victims have a rough deal. "By comparison with 14._____counties, the benefits are rather low," says Sergei Kolesnikov, a Member of Parliament and deputy of the Duma's healthcare 15._____. Another problem: Chernobyl veterans have difficulty proving their diseases are linked to the 16._____. They accept that some health problems, such as cardiovascular diseases and cancer, aren't unusual among aging Russians.

Whatever benefits they receive, those involved in the accident are branded by it. Survivors tell terrible stories: of seeing friends so burned they seemed to have been cooked; of meeting the first firemen to enter the reactor building, who vomited 17._____because of radiation exposure and died soon after. And they have strange, alluring memories of the18._____, which is slowly killing them. Oleg Genrikh, an operator at Chernobyl with burns across his body, would sometimes watch the glowing radioactive fuel when the reactor was 19._____for repairs. "It was like the northern lights," he says dreamily. "It was so beautiful. It cast a 20._____on you—even if you didn't want to look at it, you couldn't help it."

Exercise 5: Complete the Crossword using words from the text

Chernobyl



Across

1. By 1986 the sarcophagus containing the reactor was completed using more than 7,000 tonnes of steel and 410,000m3 of _____

4. 30 seconds after the start of a safety test in Chernobyl, there was an unexpected power _____.

6. The _____ covering of the reactor burned for nine days, churning huge quantities of radiation into the atmosphere.

8. Gudz says that Chernobyl's second generation now suffers from birth defects, _____ problems, cancer and other conditions.

12. The resulting plume of _____ smoke rose about one kilometre into the air.

14. Despite the obvious dangers the response to the disaster needed_____ .

15. The long-term impact of the radiation has proved impossible to_____ .

18. A study estimates that by 2065, Chernobyl will lead to a total death _____of between 30,000 and 60,000 people.

20. There is a lot of confusion about how many excess _____ deaths will likely result from the 1986 Chernobyl accident.

21. The greatest problem with the sarcophagus was its lack of_____.

22. Following the explosion, a massive concrete _____ was constructed around the damaged no. 4 Reactor.

23. There is no certainty as to how much _____ has been left inside the reactor.

24. More than 30 years after the world's worst nuclear_____ , experts still can't agree how many people it killed.

25. Today, Chernobyl liquidators are still suffering from the irreversible _____ to their health.

Down

2. In the final phase of firefighting, the core of the reactor was cooled with _____.

3. On April 26, 1986, the world's worst _____ accident happened at the Chernobyl plant.

5. Initial attempts to extinguish the burning reactor involved fire fighters pouring cooling water into the _____.

7. The people who worked to contain the Chernobyl disaster were termed _____.

9. Thousands of military personnel and other workers were drafted in to move _____ radioactive material.

10. The 600 men of the plant's fire service and the operating crew were the most severely _____ group.

11. Water is leaking through the sarcophagus via holes in its _____.

13. From 27 April to 5 May, more than 30 military _____ flew over the burning reactor.

16. The accident released more radiation than the deliberate dropping of a nuclear bomb on _____.

17. An increased risk of _____ cancer in exposed children has been clearly demonstrated in the most contaminated regions.

19. The World Nuclear Association says Chernobyl is responsible for the largest uncontrolled radioactive release in human _____

ANSWER KEY:

Exercise 1: True or False key

1. T 2. F 3. T 4. F 5. T 6. T 7. T	8. T 9. F 10. T 11. T 12. F 13. T 14. T 15. F

Exercise 2: Definitions key

1. attempts = efforts 2. classified = withheld from general circulation for reasons of national security 3. contaminated = infected, polluted, corrupted 4. deliberate = on purpose 5. distorted = twisted 6. extinguish = put out 7. fatalities = deaths, casualties	8. fragments = pieces, parts broken off 9. integrity = an unimpaired condition 10. massive = huge, enormous 11. prevent = to keep from happening 12. quantify = measure the quantity 13. sarcophagus = a stone coffin / tomb 14. seeps = to flow through fine pores or small opening 15. smother = to kill by depriving of air

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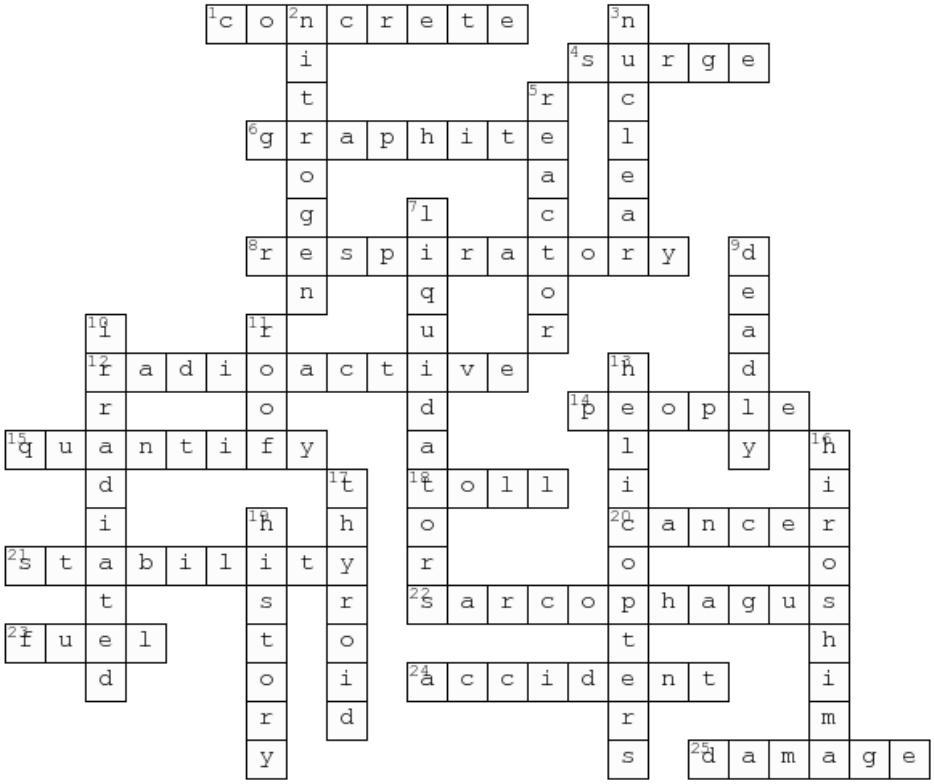
Exercise 5: Crossword key



Across

1. By 1986 the sarcophagus containing the reactor was completed using more than 7,000 tonnes of steel and 410,000m3 of _____ (**concrete**)
4. 30 seconds after the start of a safety test in Chernobyl, there was an unexpected power _____. (**surge**)
6. The _____ covering of the reactor burned for nine days, churning huge quantities of radiation into the atmosphere. (**graphite**)
8. Gudz says that Chernobyl's second generation now suffers from birth defects, _____ problems, cancer and other conditions. (**respiratory**)
12. The resulting plume of _____ smoke rose about one kilometre into the air. (**radioactive**)
14. Despite the obvious dangers the response to the disaster needed_____ . (**people**)
15. The long-term impact of the radiation has proved impossible to_____ . (**quantify**)
18. A study estimates that by 2065, Chernobyl will lead to a total death _____of between 30,000 and 60,000 people. (**toll**)
20. There is a lot of confusion about how many excess _____ deaths will likely result from the 1986 Chernobyl accident. (**cancer**)
21. The greatest problem with the sarcophagus was its lack of_____. (**stability**)
22. Following the explosion, a massive concrete _____ was constructed around the damaged no. 4 Reactor. (**sarcophagus**)
23. There is no certainty as to how much _____ has been left inside the reactor. (**fuel**)
24. More than 30 years after the world's worst nuclear_____ , experts still can't agree how many people it killed. (**accident**)
25. Today, Chernobyl liquidators are still suffering from the irreversible _____ to their health. (**damage**)

Down

2. In the final phase of firefighting, the core of the reactor was cooled with _____. (**nitrogen**)
3. On April 26, 1986, the world's worst _____ accident happened at the Chernobyl plant. (**nuclear**)
5. Initial attempts to extinguish the burning reactor involved fire fighters pouring cooling water into the _____. (**reactor**)
7. The people who worked to contain the Chernobyl disaster were termed _____. (**liquidators**)
9. Thousands of military personnel and other workers were drafted in to move _____ radioactive material. (**deadly**)
10. The 600 men of the plant's fire service and the operating crew were the most severely _____ group. (**irradiated**)
11. Water is leaking through the sarcophagus via holes in its _____. (**roof**)
13. From 27 April to 5 May, more than 30 military _____ flew over the burning reactor. (**helicopters**)
16. The accident released more radiation than the deliberate dropping of a nuclear bomb on _____. (**hiroshima**)
17. An increased risk of _____ cancer in exposed children has been clearly demonstrated in the most contaminated regions. (**thyroid**)
19. The World Nuclear Association says Chernobyl is responsible for the largest uncontrolled radioactive release in human _____ (**history**)