**Nuclear Bombs**

Okay. Hi. Nuclear bombs. Ten minutes. Go. Right we're going to talk about nuclear bombs today. We can't talk about nuclear bombs without talking about how they work. So, we have to try and understand two different processes: fission and fusion. I'm going to try and explain both these processes, however my background is in English literature not in physics, so I'll do my best. Here we go. Fission first. Fission means splitting up of something. In this case, splitting up of an atom. What happens in nuclear fission is you get an unstable isotope, usually something like uranium 235, and what that is is an atom that has the same number of protons but a different number of neutrons. And they fire a neutron at that atom very very fast. And when that neutron hits the atom it makes it unstable and the atom breaks into two halves. In the separation process it releases a vast amount of energy and also it releases neutrons again, and those neutrons hit another atom which split that up and those neutrons hit another atom, and this keeps going. We have a cycle. It goes critical. OK? That's how nuclear fission works. Nuclear fission is used in any nuclear power station … nuclear reactor. They use nuclear fission to produce energy. They use the energy to heat water. They use this resulting steam to drive a generator which makes electricity, of course. The problem with nuclear fission is you get a leftover product. You get a lot of radioactive matter that's left behind and that has to be stored and it stays radioactive for tens of thousands of years. So, they have to bury it in different places. A lot of problems with that.

Fusion. Now, fusion means putting things together. If you fuse two things together, you put them together. So, what happens in fusion is two separate elements merge to make another one. You have low mass isotopes, something like hydrogen, which unite under very high pressure and a very high temperature. The sun makes its power … the sun makes its energy through nuclear fusion. On the sun, you have two materials, tritium and deuterium, which fuse together to make helium. When these two elements fuse together, they create a vast amount of energy. Nuclear fusion makes more energy than nuclear fission. There are also no byproducts. The sun has so much energy … so much material that it's going to be doing nuclear fusion for the next 10 billion years. There are many problems with nuclear fusion we can't actually do it yet because it has to be ignited under a perfect … in under perfect conditions. It must be the perfect temperature, not too hot or not too cold, and it must have an ignition source which is very difficult to do. We’re going to talk about that in a little bit as well. One of the goals of course for the future is cold fusion, where you can make a fusion reaction happen without the heat. We'll talk about that in a bit.

Anyway, let's go back to fission. So, a man called Otto Hahn discovered nuclear fission in 1934. Now, a lot of research put into that, of course, but, as with anything, most of the research money came about when World War Two started. A lot of developments in the world come about because of war, of course. The Manhattan Project, you've obviously heard of. 1942 to 1946, the Manhattan Project were a team of scientists … nuclear physicists and scientists and physicists from all over the world who united in America to basically create the first nuclear bomb … the first atom bomb. OK? Of course, the first bomb they made was a fission bomb because fusion, even now, fusion is not a perfect science. So, they made a fission bomb. What happens with a fission bomb is you have the bomb and, it doesn't hit the ground, of course, it explodes in the sky. A … an explosive fires uranium at high speed into the trigger and of course this sets off the neutrons firing. And this makes the … the uranium or the plutonium or whatever is used go subcritical …er supercritical … sorry. That means the chain reaction starts going and going and going and this releases more and more and more energy of course. The first atomic bombs, of course, were dropped on Hiroshima and Nagasaki. I’m sure you know that. Those bombs were the equivalent of 18,000 tons of TNT. Now, when a nuclear bomb explodes, what happens? Well, of course, we have the shockwave. I mean you're releasing all of this energy. There is a shockwave as it pushes the air through the sky. And this shockwave destroys … well it kills within a certain region and then it knocks down buildings and it slowly dissipates, but the shockwave comes first. Then, of course, you have the heat. The heat from the blast in the center causes fires and, well, basically vaporizes things in that area. And then you have radiation. Nuclear fission … uranium is a very radioactive material so, after the explosion finishes, you are left with a lot of radiation fallout in the sky. And you also have an EMP. This is where … electromagnet … an electromagnetic pulse. This is where neutrons fire out and they destroy circuitry. So, a nuclear bomb these days would stop any computer or anything that uses a circuit in the area from working.

So, the first bomb dropped on Hiroshima Nagasaki. We're not going to talk about why. That's a talk for a different day. That was a fission bomb of course. Fission bombs were gradually improved, gradually made bigger and more powerful, until the most powerful fission bomb was called The Ivy King in 1952. This bomb was the equivalent of 500,000 tons of TNT. Now bear in mind that Hiroshima was 18,000 tons of TNT. We're already becoming much much more powerful. We have bombs now that can destroy huge areas not just one city. However, the problem with a fission bomb is you're limited by the amount of material you can carry because you can only use the material you have, the … the atoms split, you need atoms. The more atoms you have the more powerful it can be. But you're limited by the amount of plutonium you can put on one of these bombs. So, of course, we need to improve. If you look through the history of our world, we're always trying to find new and better weapons. So, what we come up … well, what they came up with next is a fusion bomb. Now, we talked about the fusion process. With fusion, you need a huge amount of heat to start the fusion reaction going. Now, how do you get that with a nuclear bomb? The only way they know to do it is to attach another nuclear bomb to the nuclear bomb. So, basically, what happens is you have a regular fission bomb and in the middle of that you have a fusion bomb. So, when the bomb is dropped it reaches its specific height and the fission bomb ignites, the same way as a fission … a regular fission bomb, it ignites and what that does of course is it creates a huge amount of energy a huge amount of pressure and a huge amount of heat. And it heats plastic in a core which melts and becomes a liquid plasma. And at the bottom of the bomb you have the fusion material surrounded by plutonium the fission material. And this melted plastic causes another fission reaction outside and inside and … which sets off the fusion reaction, which releases huge amounts of energy. There is no way yet to start a fusion bomb without using a fission bomb. There are ideas to use lasers and things like that, but it’s … this is talk for the future. The American military has spent hundreds of millions, probably even billions of dollars trying to invent this because whoever has one of these will rule the world, basically. So, anyway, once fusion bombs, well, fission fusion bombs are started, they get larger and more powerful because you don't need as much material. 1961, the Tsar bomb in Russia was the equivalent of 50 million tons of TNT. That's about 3,333 times as strong as the bomb on Hiroshima was.

So, the bombs we have now are far more powerful than the bombs we used to have. We have enough bombs on Earth now to destroy Earth thousands of times over. OK. So, we talked about how bombs destroy. Let's talk about how many bombs there are in the world. Which country do you think has the most nuclear bombs? Well, it's actually Russia. Russia has 7,500. America has 7,200. France has 300. China has 250. The U.K. has 215. Pakistan 100. India 100. Israel 80. And North Korea, we don't know, but probably about 10. That's a lot of countries that have nuclear bombs of course. So why do they have them? Why do all these countries have nuclear bombs? Well, of course, the idea is mutually assured destruction. What does that mean? Mutually assured destruction means if you have a gun, I get a gun. If you shoot me, I'm going to shoot you. So, you won't shoot me because you know I would shoot you. If you have a nuclear bomb and I get a nuclear bomb, you won't launch your bomb because you know I will launch my bomb and I won't launch my bomb because I know you will launch your bomb. Mutually assured destruction means we won't launch our own weapons because we don't want to be destroyed. Ok? So, this is the basic idea.

Now, this works as long as governments … as long as regular governments stay in power, as long as they can control their military. What happens of course though, with terrorism or civil war? What happens in the future? Because these bombs are getting smaller and more powerful, what happens if a terrorist organization can get their hands on a bomb? The manufacturing … the plans of these bombs are kept very classified because they don't want people to make them. It's very difficult to make a bomb. To get your hands on this uranium. However, when countries collapse, like the USSR collapsed in the 1990s, when countries collapse, they lose track of some of their missiles. Some of Russia's nuclear bombs have actually disappeared. They don't know where they are. So, if terrorists managed to get their hands on one of these bombs, which I'm sure is the goal for many terrorist organizations, what would stop them using them? The end of the world could happen not because of mutually assured destruction but because of one group just deciding to launch it. Now, currently nuclear bombs are the most powerful weapons we have on the Earth. However, humankind is always looking for more powerful and deadlier bombs so who knows what we're going to have in the future. However, to finish, from the Manhattan Project there … one of the scientists was called J Robert Oppenheimer. I think he was in charge of the project. And, when the first nuclear bomb was tested, he quoted an Indian poet, and he said, “I am become Death, the Destroyer of Worlds.” Which is very true. He had created the first weapon that could destroy a world not just a few people. So, now we have planet destroying weapons. What's going to happen in the future? I have no idea. Hopefully, the world will see sense and we will start to cut back on nuclear weapons. But, it doesn't seem to be happening.

Anyway, thank you for listening. That was nuclear bombs. I hope you understood it. It was a little bit difficult to explain. Now you’ve finished listening to the talk, try the questions. If you click on the link below here in the description box you can find questions for this talk. You can find essay questions, multiple choice questions, you can find simple answers. You can also find the transcript, so you can read it and you can download the MP3 if you want. If you practice your English, if you write and if you listen and if you read and if you talk, your English will get better. Keep trying. Do your best. Thank you for listening. If you liked this click “like”. If you want to share it click “Share”. If you want to subscribe, that button’s over here somewhere, looks like my head. Thank you for listening. Have a great week. I will try and be back next week. Bye.

**Nuclear Bombs Questions**

1. What is the main difference between fission and fusion?

A: Fission is putting two things together and fusion is splitting one thing in two.

B: Fission is splitting one thing in two and fusion is putting two things together.

C: Fission is adding an atom and fusion is taking an atom away.

D: Fission is taking an atom away and fusion is adding an atom.

2. What is released when an atom splits?

A: A lot of neutrons.

B: A lot of atoms.

C: A lot of energy.

D: A lot of protons.

3. What does “critical” mean?

A: There are too many atoms in the space.

B: The reaction becomes self-sustaining.

C: The nuclear fuel is used up very quickly.

D: The protons and neutrons are equal.

4. What is a problem when nuclear fission is used to make energy?

A: The water gets too hot.

B: There is an explosion.

C: There is too much steam.

D: There is a very radioactive matter left behind.

5. How does the sun make its energy?

A: By nuclear fission.

B: By turning water to steam.

C: By nuclear fusion.

D: By being highly radioactive.

6. What was the Manhattan Project?

A: An effort to make Manhattan a better place to live.

B: A group of international scientists trying to make a nuclear bomb.

C: A team of scientists from New York working together to make cold fusion.

D: A collection of people who were against nuclear weapons.

7. Which of these is NOT a way that nuclear bombs cause destruction and death?

A: Heat

B: Pressure wave

C: Gas

D: Radiation

8. What is the biggest problem with fission bombs?

A: They are limited by the amount of fuel they can carry.

B: They are too powerful.

C: They must always be detonated above the ground.

D: They are too expensive.

9. What is used to ignite a fusion bomb?

A: A laser.

B: Heat.

C: Plastic.

D: A fission bomb.

10. Which country has the most nuclear weapons?

A: America

B: China

C: Russia

D: India

11. Explain the idea behind Mutually Assured Destruction.

12. Do you think we will ever live in a world without nuclear weapons?

13. Donald Trump wants the other countries in NATO to increase their military spending as a percentage of GDP. Do you think countries should increase or decrease their military spending?

14. The Dominican Republic has done away with its military. Do you think we will ever live in a world where militaries are not necessary?

15. Will humankind still exist in a thousand years’ time?

**Nuclear Bombs Answers**

1. B 2. C 3. B 4. D 5. C 6. B 7. C 8. A 9. D 10. C

11. Explain the idea behind Mutually Assured Destruction.

 Mutually Assured Destruction is the idea that possessing a powerful weapon will deter any other country from attacking you because you will attack them in return. If an attack is launched, it is assured that both countries (mutual) will be destroyed. However, Steven uses the example of a gun and I don’t think that fits. If you shoot someone who is holding a gun in the head, they will not be able to shoot you back. That is not mutually assured destruction. A nuclear weapon is not the same as a gun in this respect because it takes minutes for the missile to hit once launched. That is plenty of time for a counterstrike to be launched. Say, for example, Russia fires missiles at America. American satellites and early warning systems will be aware of it in a few seconds. While trying to establish what happened, through connections with the Russian government, American missiles in Europe will be launched to try to shoot the Russian nuclear missiles down. This will probably not be successful. If it is established that the missiles were launched as an accident, both sides will attempt to detonate the missiles in the air. If that is unsuccessful, America may decide to absorb the strike without retaliating. If it is established that the missiles were launched intentionally, as an act of war, America will probably decide to launch a counterstrike back at Russia. The missiles will be authorized and fired. All of this will happen before the Russian missiles can enter American airspace. Once the Russian missiles hit their targets, American infrastructure may very well be destroyed, but the missiles will already be on their way and there will be nothing Russia can do about it. The missiles will strike and both countries will end up destroyed. Mutually assured destruction. The only way Steven’s gun analogy works is if the person shot first becomes a zombie and shoots the first person back. The fact that the acronym for Mutually Assured Destruction is MAD is probably not an accident.

12. Do you think we will ever live in a world without nuclear weapons?

 Yes, I do, but not because we have become more peaceful, but because we have found weapons that are more powerful and that render nuclear weapons useless.

 The reason that countries keep their nuclear weapons is to defend against another country that might have weapons. If any country gives up their weapons they would be trusting in the idea that the other country will give up their weapons as well. In the current international climate, no one country seems to be able to completely trust any other country so I don’t see this happening. Also, there is the constant fear that a terrorist organization will get their hands on a weapon and launch a strike. This situation is a slight exception in my opinion, though, because most terrorist organizations are not affiliated to any one country so a retaliatory nuclear strike would not be possible.

 Once we have invented a weapon, we can never uninvent it. The knowledge will always be there, so it is very unlikely that any country that has one would be able to give up their nuclear weapons. However, the hunt for more powerful weapons is ongoing, and I’m sure, at some point, a far more powerful weapon will be discovered. Once it is, nuclear weapons might be rendered insignificant. “Will we ever live in a world with weapons of any kind?” might be a more suitable question.

13. Donald Trump wants the other countries in NATO to increase their military spending as a percentage of GDP. Do you think countries should increase or decrease their military spending?

 I think we should ignore Donald Trump and decrease military spending forthwith. Most developed countries that have a large military are living under the misapprehension that a large military is still useful, and they are sacrificing the wellbeing of their populations at the same time

 Countries that have a large military are convinced that they need a large military to defend themselves from threats or attack. This is a mistaken idea for two reasons: all attacks in recent years have been carried out by small groups of people and almost all large countries are only interested in their own defense and not attacking.

 If you look at every attack on a developed country over that last half century, it has come from terrorists. These are small groups of people looking to instill fear through attacks on civilian centers. A large military cannot and does not prevent such attacks. In fact, one could argue that reducing the size of a country’s military and presence in other countries would significantly reduce these attacks. And, secondly, most countries have a large military because other countries have a large military. But those countries only have a large military because the first country has a large military. It is an illogical circle. Were a developed country to take the first step and reduce their military, rather than attacking, they would probably find that other countries would follow suit.

 When a country increases its military spending, it must do so at the expense of other services. Developed countries that have a large military also have poverty, failing education systems, poor healthcare systems, inequality in their prison systems and a myriad of infrastructure problems that could be fixed were the money allocated for the military redirected to them. Defense first is a strange idea in the modern age. It should be, healthy, well-educated and well-off citizens first, defense second. Maybe, one day, it will.

14. Costa Rica has done away with its military. What do you think about this?

 I think it is the first step that all countries should take. In 1949, Costa Rica abolished its army and said that it would be replaced with “an army of teachers”. Since then, Costa Rica has utilized all of the money it would have spent on its military on education and health care. The result is that 97% of the population is literate, the highest in Central America, and the life expectancy is 81 years, also the highest in Central America. Last year, the USA spent about $650 billion dollars on its military, and is just the amount it published, which is close to 4% of its GDP. Imagine if it had used that money for schools or health care?

 Some might argue that Costa Rica can only afford to abolish its military because it has the protection of countries with powerful militaries, such as the USA. It can spend money on its schools and health care systems because America spends so much on its military. But, this is only true if you assume that every country is always at risk from every other country, and this is obviously not true.

15. Will humankind still exist in a thousand years’ time?

 This is a very interesting question. I would like to say, “yes, we will”, but I can understand why there is a strong chance that we might not be. Let’s look at global destruction, population control and global warming.

 As we are talking about nuclear weapons, the first topic has to be global destruction. There are about 15,000 nuclear weapons in the world today. If we say that one nuclear weapon can destroy one city, and consider that about 55% of the world’s population lives in cities, we can safely assume that 15,000 nuclear weapons could kill enough of the people on Earth to cause a chain that leaves no survivors. Not to mention the nuclear winter that would result. This does, however, seem an unlikely event, no matter what happens.

 A far more likely cause of global destruction is the rapidly increasing population. There is risk that at some point in the future, assuming the population keeps growing as it is, there will not be enough food or water left to feed everybody. This will result in war, famine or disease that leads to a rapid drop in population. This, however, would not wipe out all of the people on Earth, merely bring the level back down to a more manageable number.

 Global warming, in a similar way to population control, will not wipe out everybody. It will make the Earth far more difficult to live on for many people, but there will still be some people who can survive and go on living here.

 I think, barring alien invasion or an impact from an asteroid, humans will still be living here in a thousand years. What their quality of life will be like, though, is anyone’s guess.