

UNIT 9

CAN PHYSICS HELP SAVE THE WORLD?

“It is easier to denature plutonium than to denature the evil spirit of man.”

Albert Einstein

Learning Objectives

In this unit you will:

- ✓ learn the vocabulary connected with global issues
- ✓ practice word formation
- ✓ revisit Relative clauses
- ✓ read for specific information
- ✓ talk about humankind global problems and their solutions
- ✓ write an opinion essay based on a quotation

LEAD IN

1. Discuss and answer the question: Do we live in a 'wonderful world'? Why? / Why not?"

Work in two groups.

Group 1

Brainstorm your ideas to answer the question:

What makes our world wonderful?

Make notes of your ideas and be ready to comment on each item on your list in class.

Group 2

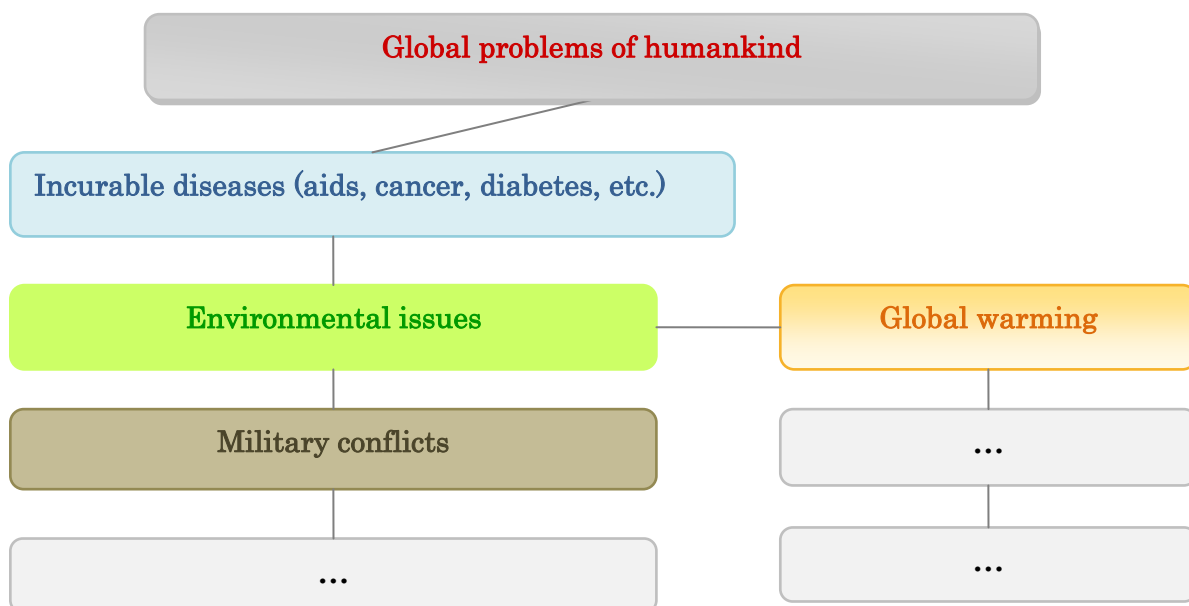
Brainstorm your ideas to answer the question:

What problems exist in this 'wonderful world'?

Fill in the diagram below and be ready to comment on it.

What makes our world wonderful?

- ✓ nature (plants, landscapes, ...)
- ✓ ...
- ✓ ...
- ✓ ...



READING

1. Read the text "What threatens our world?" and match paragraphs (A-F) to the pictures (1-6).



1. _____

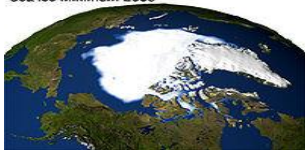
2. _____

3. _____

Sea Ice Minimum 1979



Sea Ice Minimum 2005



4. _____



5. _____



6. _____

WHAT THREATENS OUR WORLD?

Today our planet is in a serious danger. The current state of environment has reached a crisis point. Air, water and soil pollution; global warming, ozone layer depletion, deforestation, nuclear and industrial waste, plants and animals extinction are among the most burning global issues.

(A) We are fast approaching a crisis where the world's demand for energy will outstrip the resources that are available to produce it. Moreover, the best scientific evidence suggests that burning fossil fuels is responsible for the global warming that we have witnessed over the past century. The problem is that apart from nuclear power, we still lack any truly viable ways of producing energy on a large scale that do not rely on burning oil, coal and gas. It is one of the biggest challenges of the 21st century: how can the world's ever-increasing demand for energy be met without causing further damage to the environment?

(B) It hardly ever occurs to us, but "water" also has its limits, especially drinking water. Since 1975 the demand for water has doubled worldwide. The lack of pure potable water is a fact for approximately 900 million people! Every day 20.000 up to 30.000 people die from lack of pure water, that's one every 8 seconds. Many of these are children. According to some statistics two people in three across the world will face water shortages by 2025. Many of these people will be forced from their homes to seek clean water supplies elsewhere.

(C) We can no longer ignore the evidence of environmental erosion: the destruction of tropical forests, home to over half of the planet's species; the shrinking of natural habitats due to demographic and urban growth; the slow death of coral reefs, nearly one-third of which have already disappeared or suffered serious damage; the sharp decline in the numbers of large wild mammals. Today, we know that nearly 16,000 known species are directly endangered. Our generation is probably the last with the power to stop this destruction before we reach a point of no return.

(D) We still, live, as all our ancestors have done, under the threat of disasters that could cause worldwide devastation: volcanic super eruptions, asteroid impacts and others. Consider the catastrophic tsunami in December 2006, which began 350 km off the north-western tip of Sumatra in Indonesia and spread quickly across the Indian Ocean killing some 300 000 people in Southeast Asia. In total, citizens from more than 30 countries were affected, with Sweden - a country far from the Indian Ocean - alone losing more than 550 lives.

(E) Cancer, according to recent reports, kills more people than do road accidents and air accidents put together. Cancer has become the most dreaded killer disease, striking more and more people.

Cancer is a double-edged sword. It strikes a patient physically and it causes tremendous mental trauma. It is very hard indeed to accept the fact that one has cancer. Then follow the long courses of treatment - chemotherapy, surgery and radiation. They say cancer is curable if detected early. Early detections do occur but these constitute a very low percentage of the total number of cancer cases detected.

(F) Scientists and researchers from various fields tell us that the effects of climate change could be far-reaching, and, in some cases, cause serious problems. For example, rising temperatures could increase pollution and reduce air quality in heavily populated urban areas, leading to an increase in respiratory and cardiovascular diseases. Moreover global warming will have economic implications. Among them are expensive clean-up operations from the possible increase in extreme weather such as more frequent and heavy rain falls in some regions, causing rivers to flood.

Coping with the world's most serious challenges will require a variety of solutions and contributions from researchers from a wide range of disciplines. Science – and physics in particular – can play a major role in solving the problems facing humanity.

2. Read the text again. Mark the statements *T* for 'true' or *F* for 'false'. Correct the false ones and expand on the true ones.

- a) The amount of the available fossil fuel resources doesn't meet the world's increasingly growing demand for energy. ()
- b) Except for nuclear power there is no other viable alternative to fossil fuels. ()
- c) Nowadays the humankind needs 20% more drinking water than it used to in the 1970s. ()
- d) In a few decades there will start a big migration of nations caused by people's search for clean water supplies. ()
- e) Forest destruction, overpopulation and urbanization lead to the decrease in the number of the planet's species. ()
- f) Unlike their ancestors people can now monitor natural disasters much better and as a result such catastrophes no longer bring worldwide devastation. ()
- g) Road and air accidents kill more people than cancer. ()
- h) Climate change, and global warming in particular, has undesirable consequences for the world economy and people's health. ()

Study help *Reading for specific information*

Read the statements and underline the key words. Read the text to get the gist. Read again carefully. Look for synonyms/opposites or words/phrases with similar/different meanings to the key words in the statements.

Focus on language

1. Study the words and word combinations in the box and classify them under the headings (1-2). Give their Russian equivalents.

Example:

- 1) ***Problems threatening humankind:*** global warming
- 2) ***Disastrous consequences:*** increase in extreme weather

energy crisis
 damage to the environment
 lack of pure water
 increasing demand for energy
 water shortages
 environmental erosion
 destruction of tropical forests
 shrinking of natural habitats
 decline in the number of species
 climate change
 worldwide devastation
 volcanic eruption
 economic implications

asteroid impact
 catastrophic tsunami
 expensive clean-up operations
 death of coral reefs
 cancer
 mental trauma
 rising temperatures
 increase in diseases
 heavy rain falls
 pollution
 reduced air quality
 endangered species
 flood

2. Complete the table. Turn the words given in the table into *verbs*, *nouns* and *adjectives*.
 Use a dictionary if necessary.

VERB	NOUN	ADJECTIVE
	damage	
challenge		
	increase	
	reliance	
destroy		
	erosion	
		developing/developed
		urban
contribute		
pollute		
decline		
	threat	
endanger		
	devastation	
		(in)curable
reduce		
	contamination	
		(non)renewable

Add new vocabulary to your vocabulary notebook. ✍

3. Fill in the gaps with the right form of the words in capitals.

Study help Word formation

Read the sentence to get an idea what it is about. For each gap decide what part of speech the missing word is e.g. noun, verb, adverb, participle, etc. You may need to write the word in the plural or with a negative meaning. Think of prefixes and suffixes. Fill in the gap(s). Check the spelling. Read the completed sentence to check if it makes sense.

- | | |
|---|---------------|
| a) The difficulty of putting our ideas into practice us to find a new method. | CHALLENGING |
| b) We are worried by the amount of carbon dioxide in the atmosphere. | INCREASE |
| c) These days, a lot of animals are being killed by hunters and poachers. | DANGER |
| d) The existence of nuclear weapons poses a serious to the future of the world. | THREATEN |
| e) More money should be given to do medical research into diseases, such as Alzheimer's. | CURE |
| f) Many rivers and lakes have been badly by industrial waste. | CONTAMINATION |
| g) The number of whales in the oceans is one of the major concerns for marine biologists. | DECLINE |
| h) When fuels like oil and gas are being burned they release, which trap heat in the earth's atmosphere. | POLLUTE |
| i) It is very expensive to restore historical structures and buildings by acid rain. | DAMAGE |
| j) The of the protective ozone layer has caused many more cases of skin cancer. | REDUCE |
| k) Fossil fuels pollute environment and are not, so once we have burned them all up, there will be no more. | RENEW |

Discuss

- Which of the threats described in the text “What threatens our world?” are true for your country?
- Are there any solutions to these problems? What are they?
- Which fields of science could help to solve some of the global issues? In which way?

LISTENING

1. Listen to an interview with Professor Steve Cowley from the Culham Fusion science centre in Oxfordshire talking about cleaner nuclear energy production. As you listen complete the tasks (1-6).

1) Match the words with their definitions.

1. fusion

2. fission

a. *splitting very big atoms, nuclei of atoms*

b. *joining very small atoms together to make bigger nuclei*

2) Why is it not easy to get two small atoms really close to each other so that they stick together?

3) What two types of forces are there inside the nucleus? How do they act?

4) What are the names of the two kinds of hydrogen in the picture?

D (^2H)



T (^3H)



5) What two things are needed to make fusion happen in a laboratory experiment?

6) Why is fusion viewed as a clean source of energy?

2. Fill in the gaps in this interview extract with the words from the box. Listen again and check.

splitting	iron	stick	short	nuts and bolts	
powers	nuclei	stable	grab	long	gain
joining	hydrogen	same	repulsion	medium-sized	

Chris - Welcome to the Naked Scientists. How does fusion differ from fission, the thing that

1) _____ the nuclear power stations we have here in Britain?

Steve - Behind all these ways of making energy is the fact that the most

2) _____ nucleus of an atom happens to be 3) _____, right in the middle of the periodic table. It's a 4) _____ nucleus. Any way you can go towards it you can 5) _____ energy. Fission is 6) _____ very big atoms, nuclei of atoms to go towards iron. Fusion is 7) _____ very small ones together to make bigger 8) _____ to go towards iron.

It turns out that the easiest reactions to do with fusion are to join

9) _____ together to make helium.

Chris - Let's look at the 10) _____ of the fusion process then.

Steve - The problem with fusion is that in order to get them to 11) _____ together you have to get them really close. There's a force in the nucleus which is called the strong force. It only acts over a very

12) _____ distance. There's another force which is the electric force which acts over a 13) _____ distance. When you've got two nuclei far apart they repel each other because they're the 14) _____ charge. Two nuclei are both positive charges. They repel. When you get them really close together they 15) _____ each other and stick. To get them that close you have to get over that 16) _____ all the way.

Study help Gap-filling

Read the text through to get an idea of what it is about. Read again and focus carefully on the words before and after each gap. Choose the word that fits best. Read through the completed text again to check that it makes sense.

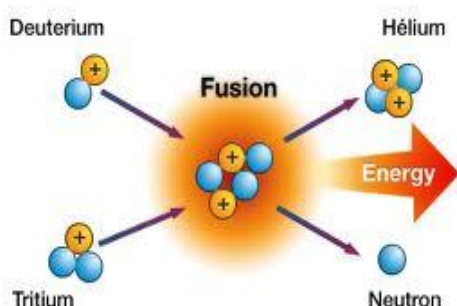
READING

1. Work in pairs. Discuss the question.

- ✓ Can physics help solve any of the global problems of humankind? Which problems and in which way?

2. Read the extracts (A-G) to learn more about the potential of physics for solving global problems. Compare the information in the extracts with your answers to the question in Task 1.

A) Physics will play a critical role in 'sustainable development'. Taking clean water as an example, membranes that are made from carbon nanotubes can be used to block the passage of bacteria, viruses, heavy metals and other pollutants. They can therefore be used as effective filters for purifying water. Several laboratory experiments have demonstrated that carbon-nanotube filters can remove viruses 25 nm in size from water, as well as larger pathogens such as *E. coli* and *Staphylococcus aureus* bacteria. Carbon nanotubes can also withstand a relatively high temperature, which means the filter could be unclogged periodically by heating it; conventional polymer-based water filters, in contrast, are destroyed if heated.



B) There is a need for research into new reactor designs and alternatives to the conventional nuclear-fuel cycle. In the longer term, fission could be replaced by fusion power. Fusion power is believed to have significant safety advantages over current power stations based on nuclear fission. In a fusion reactor there is no possibility of runaway heat build-up or large-scale release of radioactivity, little or no atmospheric pollution, the power source comprises light elements in small quantities, the waste products are short-lived in terms of radioactivity. A commercial fusion reactor is unlikely to become a reality until about 2050, however.

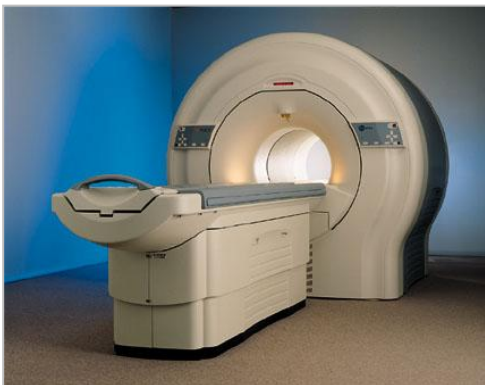
C) Particle physicists spend most of their time exploring the fundamental properties of matter, often with accelerators that cost hundreds of millions of pounds. However, some are also engaged in a more down-to-earth activity – developing new technology for medical applications. Technologies originally developed for experiments in particle physics are being used to diagnose and treat cancer. The devices are designed to ensure that a patient undergoing intensity modulated radiotherapy (IMRT) receives precisely the right dose of radiation. IMRT involves dividing the cross-sectional area of an X-ray beam into segments of different intensities. This allows clinicians to vary the radiation dose across a tumour, and more precisely match the shape of that tumour. It also means they can reduce the impact of radiotherapy on healthy tissue.

D) Meeting the world's energy demands in an environmentally acceptable way will require the development of new sources of renewable energy. There is, however, one very big problem: renewable energy is currently much more expensive than other sources of power. Reducing the cost of renewable energy is a challenge for researchers from a wide range of disciplines, including mechanical and electrical engineering, materials science, physics, chemistry and, occasionally, biology. Physicists have a much greater involvement in areas where more fundamental research is required. Chief among these areas is photovoltaics. Photovoltaic cells are semiconductor devices that convert sunlight directly into electricity.



E) More research is needed on thermovoltaic cells, which are sensitive to infrared (heat) radiation, rather than visible light, and have potential to handle far greater power densities than standard cells. Thermovoltaics can convert solar energy and also capture waste heat from existing industrial and electricity-generating processes. Heat in a solar thermal system is guided by five basic principles: heat gain; heat transfer; heat storage; heat transport; and heat insulation.

F) Many renewable sources, however, can only generate electricity at certain times, such as when it is windy or sunny; so much of the energy produced will need to be stored. At present, physics-based companies are carrying out considerable research and development in energy-storage technologies, such as utility batteries, fuel cells, flywheels, superconducting magnets, compressed-air storage, pumped hydropower and super capacitors.



G) Technology developed by particle physicists has already led to a number of breakthroughs in medical imaging, including positron emission tomography (PET), magnetic resonance imaging (MRI), computed X-ray tomography (CT) and molecular imaging. The various existing imaging technologies differ in five main aspects: (1) spatial resolution; (2) depth penetration; (3) energy expended for image generation; (4) availability of injectable/biocompatible molecular probes; and (5) the respective detection threshold of probes for a given technology. In addition, linear accelerators are used to provide energetic photons for radiotherapy.

3. Choose the best answer (a, b or c) to complete the sentences (1-6).

- 1) Carbon nanotubes...
 - a) can kill bacteria and viruses in drinking water.
 - b) get destroyed under high temperature.
 - c) can improve the efficiency and durability of water purifying filters.
- 2) Fusion power ...
 - a) is being used on most nuclear power plants nowadays.
 - b) has essential security advantages over currently used technology.
 - c) will replace fission power in the near future.
- 3) Nuclear power...
 - a) might become mainstream in a few decades because fission would be replaced by fusion power.
 - b) produces radioactive waste that cannot be utilized.
 - c) could never become a good solution to energy crisis.
- 4) Medical technologies based on developments in particle physics...
 - a) require huge financial investments.
 - b) allow doctors to effectively control the radiation dose for oncological patients and get detailed imaging of some organs.
 - c) focus on diagnostics rather than treatment.
- 5) The main problem with renewable energy is that...
 - a) it cannot be stored.
 - b) now it is less cost efficient than fossil fuels.
 - c) it requires the development of energy storage technologies.
- 6) Photovoltaic and thermovoltaic cells ...
 - a) are similar.
 - b) are absolutely different.
 - c) are both used for generating electricity from solar energy.

Focus on language

1. Read the sentences and translate them into Russian. Pay special attention to the words in bold.

- Photovoltaic cells are semiconductor devices **that** convert sunlight directly into electricity.
- The catastrophic tsunami in December 2006, **which** began 350 km off the north-western tip of Sumatra in Indonesia, spread quickly across the Indian Ocean and killed some 300 000 people in Southeast Asia.
- Physicists have a much greater involvement in areas **where** more fundamental research is required.
- Carbon nanotubes can also withstand a relatively high temperature, **which** means the filter could be unclogged periodically by heating it.

2. Study the rules in the box and apply them to analyze the sentences in Task 1. Use these rules to make up sentences in Task 3.

Relative clauses with *which, that, who, whose, where, when* and *why*

Relative clauses begin with a relative pronoun or a relative adverb.

We use:

- **Who(m)/that** to refer to people.

*The man **who/that** is talking to a student is our new physics teacher.*

- **Which/that** to refer to things.

*The proposed research will concentrate on developing a robot **which/that** is able to gather readings in three dimensions.*

- **Whose** with people, animals and objects to show possession.

*A good lab assistant is the one **whose** equipment works well.
That's the device **whose** parts were destroyed by fire.*

- **When/that** to refer to a time.

*That was the year (**when/that**) Albert Einstein formulated his famous relativity theory.*

- **Where** to refer to a place.

*The Cavendish laboratory **where** Pyotr Kapitsa worked with Ernest Rutherford belonged to the university of Cambridge.*

- **Why** to give a reason.

*The reason (**why**) the experiment failed is still unclear.*

- If relative clauses give essential information they do not have commas.

*With fusion we aim to produce a power **that** has no long-lived radioactive waste.*

- If relative clauses give extra information that can be left out, they have a comma before the clause and a comma or a full stop after it.

*My junior brother wants to study in Boston university, **where** I did my postgraduate course.*

- **Who, which** and **that** are not omitted when they are the subject of the relative clause.

*The man **who/that** is talking to a student is our new physics teacher.*

- **Who, which** and **that** can be omitted when they are the object of the relative clause.

*The book (**that/which**) he is reading now is about great space explorers.*

- **Which** can be used in a relative clause to refer to the whole sentence.

*Acid rain makes soil highly acidic, **which** leads to the drying and death of forests.*

- **What** is used in relative clauses to mean *the thing that*.

***What** the lecturer said about the consequences of acid rain was shocking.*

- **Whom, which** and **whose** can be used in expressions of quantity with **of** (some of, many of, half of, etc)

*She got a lot of job offers, **most of which** were from IT companies.*

3. Join the sentences using *who, that, which, whose, when* or *where*.

Example:

She suggested an idea. It was interesting.

*The idea (**which/that**) she suggested was interesting.*

- a) Isaac Newton was an English physicist, mathematician, astronomer and philosopher. He formulated the Law of Universal Gravitation.
- b) Vehicle exhausts contain nitrogen oxides, hydrocarbons and other chemicals. They are hazardous to health and the environment.
- c) The idea of nanotechnology was born in 1959. In that year Richard Feynman gave a lecture exploring the idea of building things at the atomic and molecular scale.
- d) Acid rain assaults buildings and water pipes with corrosion. It costs millions of dollars every year.
- e) The ancient Romans built their famous aqueducts to take the waste out of the city. They understood the connection between sewage and disease.
- f) The atmosphere is the layer of gas. It surrounds the earth.
- g) The evidence of environmental erosion is the slow death of coral reefs. One-third of coral reefs have already disappeared or suffered serious damage.
- h) Nuclear power stations are not carbon free. At these stations fossil fuels are needed to run the nuclear cycle.
- i) Nuclear power is a mature technology. Its reliability has been proven over years.
- j) Over the past century we have witnessed global warming. Global warming is caused by burning fossil fuels.
- k) Intensity modulated radiotherapy (IMRT) allows clinicians to vary the radiation dose across a tumour. It means that doctors can reduce the impact of radiotherapy on healthy tissue.
- l) These technologies are now being used to diagnose and treat cancer. They were originally developed for experiments in particle physics.
- m) The nucleus has a force called the strong force. It only acts over a very short distance.
- n) Experimental nanotechnology appeared only in 1981. In that year IBM scientists in Zurich, Switzerland, built the first scanning tunneling microscope.

Get real

Search the Internet and/or popular science magazines to find out more about the global problems threatening humankind. Choose the one you find most disastrous and prepare a PowerPoint presentation about it. Make use of these questions:

- ✓ **What causes this problem?**
- ✓ **What are the disastrous consequences?**
- ✓ **What are the possible solutions?**
- ✓ **How can physics contribute to the solution of the problem?**



SPEAKING

Make your presentation in class. Make sure you structure your talk properly and use signpost words to help the audience follow your ideas.

Study help

Signposting in speaking

Speakers make use of special words to help introduce ideas and to provide a framework for what they are saying, especially in formal speech, such as a lecture or a talk. We can think of these words as ‘signpost words’ because they direct our listening: in other words, they warn us that more information is coming and suggest what kind of information this may be: e.g. additional, positive, negative, similar, different. They may also introduce examples of a main point made earlier.

Some signpost words:

- | | |
|---|---|
| ▪ Leading towards a comparison | <i>It's like ... It's as if...</i> |
| ▪ Leading towards a contrast or opposite | <i>Despite, In spite of, On the one hand, On the other hand, However, Although, Though...</i> |
| ▪ Introducing an example of what was said earlier | <i>For instance, For example, Let me give you an example, such as ...</i> |
| ▪ Suggesting cause and effect or result | <i>In consequence, Consequently, It leads to/results in..., As a result</i> |
| ▪ Providing additional information | <i>Besides, Also, Moreover, In addition ...</i> |
| ▪ Setting out the stages of a talk | <i>Firstly..., Secondly... and thirdly; First..., Then..., Next..., Finally...</i> |

Summarizing

1. Read the text “Энергия XXI века?” and highlight the Russian equivalents to the English word combinations (1-15).

- 1) search for alternative sources of energy/alternative energy sources
- 2) a more environmentally friendly and more cost-effective energy source
- 3) to meet the demands of humankind for energy
- 4) to be a viable alternative to oil, gas and coal
- 5) solar power, hydrogen fuel cells, biofuel
- 6) the most promising energy sources of the 21st century
- 7) the main disadvantage/shortcoming of something
- 8) the high cost of the equipment
- 9) to harvest energy

- 10) to depend on weather and atmospheric conditions
- 11) to develop the concept of wind power stations
- 12) to transfer power to the earth via the cable
- 13) something like a 'kite' with a turbine
- 14) nuclear power/fission/fusion
- 15) to develop thermonuclear reactors

Add new vocabulary to your vocabulary notebook. ✍

Энергия XXI века?

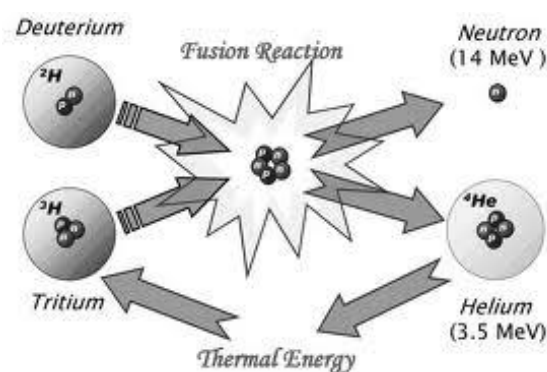
Все мы слышали о **поисках «альтернативных источников энергии»**, но в реальной жизни пока не видно особых изменений. Ученые пытаются найти более чистый с экологической точки зрения, и более эффективный с экономической источник энергии, дабы сохранить нашу планету и, в то же время, удовлетворить потребности человечества. Удается ли им это? Есть ли реальная альтернатива нефти, газу и углю?

Уже сейчас можно услышать о применении солнечной энергии, водородных топливных элементов, биотоплива и многого другого. Каковы же наиболее перспективные виды энергии XXI века?

Доступная энергия, не загрязняющая окружающую среду, буквально падает на нас с неба. Солнечные лучи несут довольно много энергии, но основными недостатками солнечной энергии являются высокая стоимость оборудования и необходимость больших пространств для сбора значительного количества энергии. К тому же получение такой энергии сильно зависит от погоды и атмосферных условий.

На сегодняшний день энергия ветра удовлетворяет лишь 0,1% потребностей человечества в электричестве. Но в будущем прогнозируется рост ее доли. Развивая концепцию ветряных электростанций, ученые предложили добывать энергию ветра на высоте 4,6 километра. Некие устройства с пропеллерами (которые также могут работать в качестве турбин) будут висеть в воздухе и передавать энергию на землю по кабелю, что-то вроде «воздушного змея» с турбиной.

Атомная энергия, несмотря на все её опасности, является важным источником энергии. Сейчас для получения энергии используется ядерный распад, но ученые работают над созданием генераторов, работающих на принципах ядерного синтеза. Также не стоят на месте и разработки термоядерных реакторов.



2. Read the text again and summarize it in English using the word combinations in Task 1 and the phrases for summarizing.

WRITING

Read the quotations (1-4). Choose the one you like best and write an essay to express your opinion.

- 1) **"It would indeed be a tragedy if the history of the human race proved to be nothing more than the story of an ape playing with a box of matches on a petrol dump."** David Ormsby Gore
- 2) **"The more humanity advances, the more it is degraded."** Gustave Flaubert
- 3) **"Human beings invent just as many ways to sabotage their lives as to improve them."** Mark Goulston
- 4) **"Evolution is individual - devolution is collective."** Martin H. Fischer

Study help

Opinion essays

Opinion essays require your clear opinion on a topic, supported by reasons and examples. They should contain: an **introduction** (stating the topic & your opinion), a **main body** (several paragraphs each with a topic sentence presenting a separate viewpoint supported by reasons/examples, and a paragraph presenting the opposing viewpoint) & a **conclusion** (relating your opinion in other words).

Points to consider:

- Decide on your opinion before you start writing i.e. whether you agree/disagree and how strongly, as this will affect the structure of your essay.
- Use present tenses and formal style, avoiding colloquial expressions, short forms and personal examples.
- Include phrases to express your opinion, a variety of appropriate linking words and interesting techniques to begin/end your essay, e.g. a quotation, a rhetorical question, etc.

Functional Language

<i>To express opinion</i>	In my opinion/view, It seems to me that... To my mind, I (strongly/completely) agree/disagree/believe that... I am totally against...
<i>To list points</i>	First of all, In the first place, Firstly/Secondly, To start with, To begin with
<i>To add more points</i>	Also, Moreover, Furthermore, In addition, Besides, Apart from this, Another major reason
<i>To introduce contrasting viewpoints</i>	On the other hand, However, It is argued that... Opponents of this view say
<i>To introduce examples</i>	For example/instance, such as, in particular, especially...
<i>To conclude</i>	To sum up, In conclusion, All in all, All things considered, Taking everything into account...

Here are some words and phrases that can be useful when you speak about global problems of humankind and their possible solutions. Read the definitions and think of the proper equivalents in Russian.

fossil fuel	Any hydrocarbon deposit that can be burned for heat or power, such as petroleum, coal, and natural gas.
greenhouse gases(GHG)	Gases present in small quantities in the atmosphere which absorb a part of the energy reemitted by the Earth and enable it to maintain an average temperature which can support life: water vapour (H ₂ O), carbon dioxide or carbonic gas (CO ₂) and methane (CH ₄). Their sharp increase due to human activities is the main cause of climate change.
greenhouse effect	The rise in temperature that the Earth experiences because certain gases in the atmosphere trap energy from the sun. Because of their warming effect, these gases are referred to as greenhouse gases. Without them, more heat would escape back into space and the Earth's average temperature would be about 33°C colder. Similarly, their rapid accumulation in the atmosphere can lead to rising temperatures.
non-renewable resource	A resource that is not replaced or only replaced very slowly by natural processes.
renewable energy	Natural and inexhaustible energy sources. The first of these is the sun's rays and the others follow more or less directly (wind, water cycle, tides, manufacture of biomass, etc.).
chlorofluorocarbons (CFCs)	A family of inert nontoxic and easily liquified chemicals used in refrigeration, air conditioning, packaging, and insulation or as solvents or aerosol propellants. Because they are not destroyed in the lower atmosphere, they drift into the upper atmosphere where their chlorine components destroy ozone.
heavy metal	A high-atomic-weight metal such as arsenic, cadmium, chromium, cobalt, lead, mercury, uranium or zinc. Heavy metals can be toxic to plants or animals in relatively low concentrations and tend to accumulate in living tissue.
deforestation	The removal of forests by cutting and burning to provide land for agricultural purposes, residential or industrial building sites, roads, etc. or by harvesting the trees for building materials or fuel.
habitat	The natural home of a plant or animal.
environmental impact	Anything which causes the deterioration of our environment, either by using non-renewable resources (oil, coal, plastics, etc.) or by producing harmful products (waste, air, water and soil pollution).
sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
green technology	The adoption of environmentally friendly tools and methods for energy production, industry, and agriculture.

Progress Monitoring

In this unit you have worked on the vocabulary on the topic: “Physics for Solving Global Issues”.

Tick (V) the points you are confident about and cross (X) the ones you need to revise.

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|---|--|
| 1. scientific evidence | 11. to have economic implications |
| 2. fossil fuels/renewable energy | 12. global/environmental issues |
| 3. to cause serious problems/damage to sth | 13. to cope with challenges |
| 4. to face water shortages/lack of pure water | 14. fission/fusion nuclear power |
| 5. destruction of forests/deforestation | 15. sustainable development |
| 6. shrinking of natural habitats | 16. to have significant advantages over sth |
| 7. to reach a crisis point/a point of no return | 17. environmentally acceptable way |
| 8. a threat of disasters | 18. to require fundamental research |
| 9. a double-edged sword | 19. to develop technologies for medical applications |
| 10. far-reaching effects of sth | 20. to reduce the impact of sth on sth |

Progress Test

1. Cross out the odd word. Explain your choices.

- a) damage, danger, destruction, devastation
- b) shrinking, reduction, challenge, decline
- c) demand, growth, rise, increase
- d) to endanger, to affect, to strike, to detect
- e) pollutants, bacteria, viruses, pathogens
- f) accelerators, flywheels, capacitors, applications

2. Give English equivalents to these Russian word combinations.

- a) устойчивое развитие
- b) ископаемое топливо
- c) возобновляемая энергия
- d) топливный элемент
- e) энергия ядерного синтеза
- f) текущее состояние окружающей среды
- g) момент, с которого возвращение назад невозможно/точка невозврата
- h) далеко идущие последствия

3. Write the word and the Russian equivalent next to each transcription.

e.g. ['baɪəʊkəm'pætəbl] – biocompatible – биосовместимый

- a) ['hæbɪtæt]
- b) [ˌɪnsjə'leɪʃ(ə)n]
- c) ['spiːʃɪz]
- d) [ˈvaɪərəs]
- e) [ˌθɜːmə'njuːklɪə]
- f) ['tjuːmə]
- g) ['haɪdrədʒən]

4. Put in *which*, *who* or *that*.

- a) The skill and inventive genius of physicists and engineers have led to the development of many of the instruments and techniques form a vital part of modern medicine.
- b) Alexander Bell was the man invented the telephone.
- c) The world's population is growing very fast makes the world critically short for food and water.
- d) The physical scientists work in medical physics and engineering may be physicists, engineers, applied mathematicians or computer scientists.
- e) The medical physicist is called upon to contribute clinical and scientific advice and resources to solve the numerous and diverse physical problems arise continually in many specialized medical areas.
- f) Our modern lifestyle is destroying the fragile environment leads to the environmental catastrophe.