

МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ  
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**РОССИЙСКИЙ ГОСУДАРСТВЕННЫЙ  
ГИДРОМЕТЕОРОЛОГИЧЕСКИЙ УНИВЕРСИТЕТ**

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**Учебное пособие по английскому языку для студентов  
магистратуры в сфере наук о Земле**

Для высших учебных заведений

Учебное пособие

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Учебное пособие предназначено для обучения английскому языку студентов магистратуры по направлениям 05.04.05 – Прикладная гидрометеорология, 05.04.06 – Экология и природопользование, 20.04.01 – Техносферная безопасность. Целью пособия является формирование коммуникативных умений, необходимых для общения в сфере экологии, природопользования, природоохранной деятельности, метеорологии и климатологии.

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## ВВЕДЕНИЕ

Учебное пособие предназначено для обучения английскому языку студентов магистратуры по направлениям 05.04.05 – Прикладная гидрометеорология, 05.04.06 – Экология и природопользование, 20.04.01 – Техносферная безопасность. Целью пособия является формирование коммуникативных умений, необходимых для общения в сфере экологии, природопользования, природоохранной деятельности, метеорологии и климатологии.

Учебное пособие может быть использовано для организации как аудиторной, так и домашней работы обучающихся.

Ниже представлены русские эквиваленты и объяснение некоторых из используемых в пособии формулировок заданий.

**Introduction.** Введение. Данный пункт содержит вводные вопросы и задания, которые предлагаются студентам, когда они приступают к изучению новой темы. Цель этих заданий – подготовить обучающихся к восприятию текстов, включенных в раздел, сформулировать актуальность изучаемой темы. Кроме того, эти задания позволяют познакомить обучающихся с новыми словами и с теми понятиями, которые они обозначают, а также повторить уже известные им лексические единицы, продемонстрировать, как они могут быть связаны с новой темой.

**Grammar.** Грамматика. Упражнения, направленные на формирование грамматических навыков.

**Vocabulary.** Лексика. Упражнения, направленные на усвоение новых слов и словосочетаний и формирование навыков их использования в речи.

**Word formation.** Словообразование. Задача состоит в том, чтобы вспомнить или найти в словаре и записать однокоренные слова.

**Skills development.** Задания, направленные на формирование умений выполнения коммуникативных задач с использованием изученного лексико-грамматического материала. В заданиях данного типа могут быть задействованы умения устной и письменной речи.

**Speaking.** Задания, направленные на формирование умений устной монологической и диалогической речи.

**Reading.** Большинство из включенных в пособия заданий на чтение предполагают поиск в тексте информации, необходимой для ответа на поставленные вопросы. От студентов требуется сформулировать ответы на английском языке, если в задании не указано иначе. Приветствуются ответы, в которых студенты своими словами передают содержание текста на английском языке. Перевод текста выполняется после завершения основного задания.

**Unit 1**  
**Speaking About Your Course of Study**

**1. Introduction.**

**QUIZ**

**How well do you know your university?**

- a) What does RSHU stand for?
- b) Can you pronounce 'hydrometeorological' correctly? How do you pronounce letter 'y'?
- c) Look at the names below. Translate them into Russian.
- Meteorological Faculty;
  - The Institute of Hydrology and Oceanology;
  - Ecological Faculty;
  - The Institute of Information Systems and Geotechnologies.
- d) What faculties (institutes) do the following departments belong to?
- Meteorological Forecasts Department;
  - The Department of Experimental Physics of the Atmosphere;
  - The Department of Integrated Coastal Zone Management;
  - The Department of Marine Information Technologies;
  - The Department of Applied and Systems Ecology;
  - The Department of Engineering Hydrology
  - The Department of Geoecology, Environmental Management and Ecological Safety
  - the Department of Aquatic Bioresources, Aquaculture and Hydrochemistry
- f) Put the programmes in the chronological order:  
*a PhD programme, an Undergraduate course, a Master's course.*

**2. Vocabulary.** Words and phrases you should know to talk about a course of study. *University, study, faculty, department, subject, research, undergraduate programmes, bachelor's degree, master's degree, qualification, lectures, laboratory classes, practicals, seminars, apprenticeship, full-time course, part-time course, field training, field station.*

Divide the words into groups to talk about the following:

University structure: \_\_\_\_\_

The process of study and types of work: \_\_\_\_\_

Programmes of study: \_\_\_\_\_

3. **Word formation.** Use a dictionary to fill in the chart. For some words you have to leave one or two spaces blank.

Noun	Person	Adjective	Verb
Science			
Study			
Environment			
Meteorology			
Development			
Postgraduate			
Apprenticeship			
Technology			
Research			

4. **Reading and vocabulary.**

Do you know what the following subjects study? Match each of the subjects with a definition. What do you call specialists who work in each sphere? What suffixes do you use?

1. Ecology	a) studies the Earth's atmosphere and its changes, which forms the base for the weather forecast
2. Meteorology	b) studies the ocean including marine organisms, ocean currents, waves, the geology of the sea floor
3. Oceanography	c) studies the relation between plants, animals and people and their environment
4. Climatology	d) studies movement, distribution and quality of water throughout the Earth including water resources and environmental sustainability
5. Biogeography	e) studies climate
6. Hydrology	f) studies distribution of species throughout the Earth

5. **Pronunciation.** Как произносятся подчеркнутые буквы (сочетания букв)?

Hydrology, systematic, Physics, climate, species, environmental, applied, distribution, biodiversity, science, satellite.

6. **Vocabulary.** Explain the difference between the words in each pair.

1. ecology, environment
2. climate, weather
3. forecast, prediction
4. faculty, department

5. animals, species
6. programme, course
7. programme, program
8. subject, discipline

**7. Reading.** Read the text and find information about the following.

- What does the program concentrate on?
- Where do the graduates work?
- What subjects does the program include?

### **Meteorology**

This program focuses on the study of atmospheric processes and climatic variability. Upon completion of the program (operational emphasis), students will meet the requirements for the National Weather Service, the private meteorology sector, or continue their education in graduate school. Students choosing the program with the broadcast emphasis can also work for the National Weather Service and also earn the American Meteorological Society's Certified Broadcast Meteorologist Seal of Approval.

The Professional Meteorology Program (PMP) track prepares students for graduate school and/or a career as an operational forecaster. Outside of the core meteorology curriculum, PMP students take courses in advanced mathematics, statistics, computer programming, Remote Sensing, GIS, and other courses depending upon individual students' interests.

Source: Mississippi State University

<https://www.geosciences.msstate.edu/undergraduate/meteorology/>

**8. Grammar.** Объясните разницу в формах глаголов в 1 и 2.

1. The students study .... They don't study ...
2. The programme includes ... The programme doesn't include ...

**9. Grammar.** What subjects does your course include? Which of the following don't you study? Also make negative sentences if you do not study some of the subjects.

Use the clues: the courses include ...; the programme involves ....;

The students of this programme study .....

- |                           |                         |
|---------------------------|-------------------------|
| • Sociology               | • Meteorology           |
| • Microbiology            | • Climatology           |
| • The Theory of Evolution | • Synoptic Meteorology  |
| • Philosophy              | • Satellite Meteorology |

- Biology
- Maths
- Physical Geography
- Theory of Communication
- Hydrology
- Fundamentals of Chemistry

What are your favourite subjects? Which subjects are you good at?

**10. Reading.** Read the text. Choose the best title for each of the paragraphs.

- a) Career opportunities
- b) Focus on field practice
- c) What is Environmental Geoscience?
- d) What skills do the students develop?

### **Introducing BSc Environmental Geoscience**

1. How does the environment work? Environmental geoscience is the study of processes within, and interactions between, the atmosphere, ocean and the solid Earth that determine life on the planet. It studies natural processes that have been modifying the planet over its history, but with a strong focus on understanding the modern system and how it is affected by human activities. Environmental geoscience addresses fundamental questions about the functioning of the Earth system such as: What are the drivers of climate change in the Earth's past and how will these processes change in the future? What are the impacts of changing nutrient cycling and pollution on the sustainability of marine ecosystems? How can we safely manage the use of energy and materials resources to ensure the continued functioning of modern society?

2. A strong emphasis is placed on field skills, with trips to the Lake District, Jamaica, and north-west Scotland, as well as numerous one-day trips (the location of field courses may change as our course content adapts to changing teaching needs, and student feedback).

3. You will also gain a range of transferable skills, including: written and oral reports; critical analysis and interpretation of data; group working and, as the programme progresses, the ability to manage project work, and research, independently.

4. The vast majority of our graduates move straight into degree-related employment or further study. Our graduates work for energy and resource companies, environmental consultancies and the financial sector, and many also find employment in the areas of environmental planning and regulation, conservation, science communication and education, and engineering.

Source:

<https://www.ed.ac.uk/studying/undergraduate/degrees/index.php?action=programme&code=F630> (the University of Edinburgh)

## Words and phrases to remember

interaction	observational skills	course content
to determine	nutrient cycling	to gain
to develop	sustainability	transferable skills
to affect	source	research
impact	to ensure	graduates
to enable	field skills	employment

### **11. Vocabulary.** Translate the phrases.

- To develop observational and analytical skills;
- To develop and apply new methods;
- To gain a range of transferable skills;
- To address fundamental questions about the functioning of the Earth system;
- To manage the use of energy and materials resources

### **12. Vocabulary.** Fill in the gaps with the most appropriate word, (A), (B) or (C).

In many Science and Engineering \_\_\_\_\_ (1) students spend considerable parts of their time \_\_\_\_\_ (2) practical or laboratory work. Here the learning is very 'hands on' and classes are designed to allow students to \_\_\_\_\_ (3) discipline-based skills.

Laboratory and practical classes are an important opportunity for many students to \_\_\_\_\_ (4) experimentally the concepts and methods introduced in lectures and tutorials.

Depending on the discipline and the topic, specific purposes will vary but they may include:

- an opportunity to \_\_\_\_\_ (5) theoretical and conceptual knowledge;
- development of experimental techniques and approaches;
- an opportunity to \_\_\_\_\_ (6) skills in collecting, analysing, interpreting and presenting findings and data;
- learning how to manage resources (including time);
- learning how to work more effectively and \_\_\_\_\_ (7) in a laboratory or in the field.

1. (A) lectures (B) skills (C) courses
2. (A) making (B) doing (C) carrying
3. (A) develop (B) research (C) study
4. (A) develop (B) research (C) test
5. (A) apply (B) work (C) carry
6. (A) apply (B) improve (C) carry
7. (A) concentrated (B) safely (C) fast

### 13. Word formation.

	<b>adjective</b>	<b>noun</b>
1	analytical	
2	observational	
3	applied	
4	atmospheric	
5	variable	
6	scientific	
7	theoretical	
8	resourceful	

**14. Vocabulary.** Look at the extract from WMO's Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology. Fill in the gaps.

Components of the Basic Instruction Package for Meteorologists are the following.

(a) Foundation \_\_\_\_\_ (темы) in mathematics and physics plus complementary \_\_\_\_\_ (предметы) dealing with other \_\_\_\_\_ (науки) and related topics, and \_\_\_\_\_ (анализ и применение данных);

(b) atmospheric \_\_\_\_\_ (науки):

– Physical meteorology (i.e. \_\_\_\_\_ (состав атмосферы), radiation and optical/electrical \_\_\_\_\_ (явления); thermodynamics and cloud physics; boundary-layer meteorology and micrometeorology; conventional \_\_\_\_\_ (наблюдения) and instrumentation; remote sensing;

– Dynamic meteorology (i.e. atmospheric dynamics; numerical weather \_\_\_\_\_ (предсказание);

– Synoptic and mesoscale meteorology (i.e. mid-latitude and polar weather systems; tropical weather systems; mesoscale weather systems; weather \_\_\_\_\_ (наблюдение), \_\_\_\_\_ (анализ) and diagnosis; weather \_\_\_\_\_ (прогнозирование); service delivery;

– Climatology (i.e. climates and climate services; climate \_\_\_\_\_ (изменчивость) and climate change.

Source. WMO [https://library.wmo.int/pmb\\_ged/wmo\\_1083\\_en.pdf](https://library.wmo.int/pmb_ged/wmo_1083_en.pdf)

**15. Speaking.** Prepare to talk about the university where you study, your faculty and department, your specialization, the courses you study.

## Unit 2

### Career in Ecology and Meteorology

#### **1. Introduction.**

A. What kind of job would you prefer: field-based survey work, for example collecting information about the numbers and distribution of species, or an office job (analysing and interpreting data, writing reports, etc.)?

B. Certain skills and abilities are important. Which of the following do you think you already have?

- enthusiasm for doing fieldwork in sometimes harsh conditions;
- competence in understanding and using statistics;
- the ability to use computer software for recording, analysing and presenting data and reports;
- research skills;
- excellent written communication and presentation skills;
- experience in report writing;
- confidence in using survey techniques;
- team-working and project-management skills;
- self-motivation, energy and drive.

**2. Reading.** Read the extracts from interviews with two professionals in meteorology and ecology. Who talks about the following, Naomi Bengner, Dr Joe Chipperfield or both?

- predicting the future as part of the job
- using specialised software
- conservation of species variety as the main interest
- being interested in scientific methods
- warning clients about certain hazards
- consulting the media
- producing publications for a website
- skills that will make you competitive

**Text A. Naomi Bengner** talks about her life on the job as a Meteorologist at the Bureau of Meteorology.

I work for the Bureau of Meteorology (BoM) as part of the forecaster team in the Adelaide branch. We produce the official weather forecasts for South Australia. I work two types of shift: public weather and aviation weather. Weather watching is a constant part of both shift types. On a public weather shift I work on

producing and communicating the forecast. Producing the forecast involves developing the forecast policy for the following week. We examine a few different types of computer generated forecasts then use our local knowledge and experience to decide what we expect will happen. To communicate the forecast, I do radio interviews and consult TV weather presenters and general media (TV, newspapers). We use a specialised software to format the forecast for publication on our website.

During aviation shifts we forecast weather elements that could be hazardous to aircraft and those working in the aviation industry. We forecast cloud heights, wind, turbulence and storms, for example, amongst other elements. We produce larger forecasts, which cover the whole of SA and over some of the coast, and specific forecasts also for particular locations with aerodromes and airports within South Australia. These forecasts are for, at most, 30 hours in advance.

What is important for a career like mine? Aside from the academic abilities in science, good communication skills are very important. Producing the forecast is only one aspect of the job, we need the forecast to be communicated and understood.

**Text B. Dr Joe Chipperfield** is a Research Ecologist working in the Biogeography department at the University of Trier in Germany.

The main focus of my research is the development and application of new techniques to determine the ranges of species and predict what may happen to these ranges in the future.

I've always been interested in science and the scientific methods, but definitely I've always been interested in nature and conservation. I like being able to do something that helps biodiversity, but there's also a pure scientist in me who enjoys answering questions.

My job is to create and design mathematical and statistical models which describe where species are, where they are going, and to assess the effect of different conservation strategies on species. The majority of my job is computer programming – I sometimes feel more like a computer scientist than an ecologist.

I do like it when I create a product which has an applied angle. It sounds very theoretical when I describe my job to people, but actually I've always got a focus on application. For example, one of my jobs has been to create optimal reserve networks and to assess how the current big European-wide networks help conservation.

Certainly there is a lot of daily routine. Much of my work is programming and much of programming is failure really. You try something and it doesn't work, then you change it to make it work. I know lots of people who work in the laboratory who say the same about their work. You have to be flexible and look critically at where you went wrong and try again.

The key advice I give to my undergraduates is don't underestimate the value of the quantitative methods in ecology. These are the mathematical or statistical sides of ecology; things where you apply mathematical concepts to data analysis. Only when you have these quantitative skills you can really turn it into a career. These skills are important: if you're going down a more theoretical line, then mathematics is very important. If you're going down a more field-based line then you'll still have to have good statistics skills. You can't get away from needing quantitative knowledge.

### 3. Grammar. Past Simple.

**Naomi Bengier:** I \_\_\_\_\_ (grow up) in Whyalla and Aldinga (south of Adelaide) in South Australia. I \_\_\_\_\_ (study) Mathematics at Adelaide University. I \_\_\_\_\_ (do) an exchange year in Germany and then \_\_\_\_\_ (take) a break from study to work in Switzerland for 1.5 years. After completing my studies I \_\_\_\_\_ (decide) to go to Ireland to do a PhD. I \_\_\_\_\_ (work) in academic institutions in Ireland, France and Australia for a few years, and then I \_\_\_\_\_ (decide) to change my career and become a meteorologist. The training program to become a forecaster \_\_\_\_\_ (take) 10 months. But it \_\_\_\_\_ (was) important that I \_\_\_\_\_ (have) expertise in related topics, such as maths and physics.

### 4. Vocabulary. Make phrases.

determine	new techniques
predict	the effect of different conservation strategies on species
forecast	fieldwork
work	the weather
analyse and present	what may happen to these species in the future
develop and apply	the forecast policy
assess	as a research assistant
develop	the ranges of species
do	data

**5. Vocabulary.** Fill in the gaps. Use the -ing forms to translate the professional functions. Example: *разработка новых методов – developing new methods.*

In weather forecasting, common tasks include:

- \_\_\_\_\_ and \_\_\_\_\_ (сбор и анализ данных) from satellite images, radar, remote sensors and weather stations all over the world;
- \_\_\_\_\_ and \_\_\_\_\_ (измерение и оценка факторов) such as air pressure, temperature and humidity at various atmospheric levels;
- \_\_\_\_\_ and \_\_\_\_\_ (анализ и предоставление информации) to customers in the form of weather briefings;

- \_\_\_\_\_ (применение) sophisticated computer models to make short and long-term forecasts;
- \_\_\_\_\_ and \_\_\_\_\_ (коммуникация и обмен информацией) with colleagues from around the country and worldwide.

In research, work includes:

- \_\_\_\_\_ (исследование) subjects such as airflow in the lowest kilometres of the atmosphere, the physics of clouds and precipitation, or global climate change;
- \_\_\_\_\_ and \_\_\_\_\_ (разработка и доработка (улучшение) компьютерных моделей) to predict atmospheric processes and improve the accuracy of forecasts;
- \_\_\_\_\_ and \_\_\_\_\_ (наблюдение и предсказание климатических изменений);
- \_\_\_\_\_ (исследование) changes in the stratosphere (10 to 50km above the Earth), including the ozone layer;
- \_\_\_\_\_ (оценка) the likely effects of global warming.

**6. Vocabulary.** Who would use the words and phrases below most often, a meteorologist or an ecologist (or both)? Divide the words into 3 groups.

Meteorologist	Ecologist	Both

the ozone layer, conservation strategies, species, atmospheric processes, the accuracy of prediction, reserve networks, precipitation, global climate change, computer generated forecasts, air pressure, temperature, humidity, quantitative methods, biodiversity, weather patterns, satellite images, to provide up-to-date weather information, pollution, sustainability of ecosystems.

**7. Grammar.** Present Perfect. Talking about experience. Посмотрите на пример и сформулируйте правило: в каких случаях используется Present Perfect и в каких Past Simple.

- How many CVs **have you reviewed**? How many candidates have you interviewed?
- This is a difficult question! It is true that **I have seen** quite a number of applications since **I started** this job in 2007.

Ask and answer questions about the following. Use Present Perfect.

- do fieldwork
- write a CV
- have a job interview

- prepare an environmental survey report
- participate in a conference
- communicate with foreign colleagues in English
- develop or use any software for data analysis

How did you feel? Nervous, excited, interested, or confused by the difficulties?

**8. Skills development.** В объявлениях о приеме на работу найдите и запишите на русском языке информацию о вакансиях.

Название компании (организации), отрасль	
Должность	
Обязанности	
Образование	
Опыт	
Личные качества	

**Vacancy 1. Broadcasting, Zolo Media,** is looking for a **Meteorologist** to join our team to produce daily weather content. Our goal is to provide up-to-date weather information to Central Oregonians via KOHD, KBNZ and our broadcast, cable and online platforms. High Desert weather can include complex weather patterns, from wild fires and thunderstorms to snow and sunshine.

This person will need to know how to use the science to always lead the market in weather coverage. We are looking for someone who has the ability to incorporate the scientific weather information into entertaining weather stories. This person will report the weather in the studio as well as report from field locations and community events. This person will also be responsible for publishing weather information on our website.

**Qualifications**

- Bachelor’s degree in meteorology/atmospheric science.
- Field work experience preferred.
- Certified Broadcast Meteorologist from the American Meteorology Society preferred.
- Excellent written, verbal, interpersonal and communication skills.
- Ability to meet deadlines.

**Vacancy 2.** City of Carrollton council. Water Resource Management Specialist.

SUMMARY: Responsible for developing, administering and evaluating water conservation education programs for residents, schools, businesses and community.

Give presentations related to water conservation methods, techniques, and current status within the North Texas region and the City of Carrollton.

**JOB FUNCTIONS:**

- coordinate educational programs supporting, promoting waste recycling;
- give presentations regarding water conservation and waste reduction to various community and business groups;
- design and prepare press releases, media announcements, brochures, fliers, news articles, websites and other public awareness materials for environmental education programs;
- coordinate with local businesses on water conservation programs and practices;
- assist in developing and maintaining department budget;
- develop and maintain regional contacts and actively participate in regional water conservation activities and discussions.

**KNOWLEDGE, SKILLS, AND ABILITIES:**

- knowledge of water conservation practices;
- knowledge of municipal services and operations;
- skills of preparing and giving written and oral presentations;
- skills in Microsoft Office including Word, PowerPoint and Excel;
- skilled in collecting and analyzing information and making recommendations based on findings and in support of organizational goals;
- skilled in communicating effectively with a variety of individuals;

**MINIMUM QUALIFICATIONS:**

Bachelor's Degree in Public Administration, Environmental Science and 1 year of related experience; a valid Driver's License.

**WORKING CONDITIONS:** in both standard office and outdoor environments, with potential exposure to adverse weather conditions.

**9. Skills development. Подготовка к собеседованию.** Preparing for an interview. Choose a vacancy from Ex. 8. Prepare to talk about the following.

- Your education.
- Your experience (relevant jobs, apprenticeship, volunteer work).
- Relevant skills.
- Why you might be interested in the job (your interests and ambitions).

**Проведение собеседования.** В парах проведите собеседование.

Студент 1. Менеджер организации, проводящий собеседование и отбор кандидатов.

Студент 2. Кандидат.

# ECOLOGY and TECHNOSPHERE SAFETY

## Unit 3 Climate Change

**1. Introduction.** Look at the quotations.

- a) NASA: *“Arctic sea ice set a record low in September 2007.”*
- b) IPCC: *“The global temperature will grow by 3 to 7 F.”*
- c) EU commission: *“Carbon dioxide emissions rose 3.5 % in 2009 across the European Union, as power demand and industrial output rose.”*

What do you know about the relationship between carbon dioxide emissions, average global temperature increase and melting of Arctic sea ice?

**2. Vocabulary.** Определите возможное значение следующих слов по их «родственникам» в русском языке. Значение некоторых из них может отличаться от оригинала в английском языке.

*absorb, to have an effect, record, source, radiative, trend, to generate, approximately, to contain, chemical reactions*

**3. Reading.** Find the answer to the question in Ex. 1 (Introduction) in the text below. What greenhouse gases are mentioned? Which one has the longest lifetime? Which one absorbs the most energy? What are the sources of greenhouse gases emissions?

### **Greenhouse gases**

Greenhouse gases (GHGs) warm the Earth by absorbing energy and slowing the rate at which the energy escapes to space; they act like a blanket insulating the Earth. Different GHGs can have different effects on the Earth's warming. Two key ways in which these gases differ from each other are their ability to absorb energy (their "radiative efficiency"), and how long they stay in the atmosphere (also known as their "lifetime"). Earth's 2015 surface temperatures were the warmest since modern record keeping began in 1880, continuing a long-term warming trend. Most of the warming occurred in the past 35 years, with 15 of the 16 warmest years on record occurring since 2001. Last year was the first time the global average temperatures were more than 1 degree Celsius above the 1880-1899 average, a change largely driven by increased carbon dioxide and other human-made emissions into the atmosphere.

The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is a measure of how

much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO<sub>2</sub>). The larger the GWP, the more a given gas warms the Earth compared to CO<sub>2</sub> over that time period. The time period usually used for GWPs is 100 years. GWPs provide a common unit of measure, which allows analysts to add up emissions estimates of different gases, and allows policymakers to compare emissions reduction opportunities across sectors and gases.

- CO<sub>2</sub>, by definition, has a GWP of 1 regardless of the time period used, because it is the gas being used as the reference. CO<sub>2</sub> remains in the climate system for a very long time: CO<sub>2</sub> emissions cause increases in atmospheric concentrations of CO<sub>2</sub> that will last thousands of years.
- Methane (CH<sub>4</sub>) is estimated to have a GWP of 28–36 over 100 years. CH<sub>4</sub> emitted today lasts about a decade on average, which is much less time than CO<sub>2</sub>. But CH<sub>4</sub> also absorbs much more energy than CO<sub>2</sub>. The net effect of the shorter lifetime and higher energy absorption is reflected in the GWP. The CH<sub>4</sub> GWP also accounts for some indirect effects, such as the fact that CH<sub>4</sub> is a precursor to ozone, and ozone is itself a GHG.
- Nitrous Oxide (N<sub>2</sub>O) has a GWP 265–298 times that of CO<sub>2</sub> for a 100-year timescale. N<sub>2</sub>O emitted today remains in the atmosphere for more than 100 years, on average.
- Chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF<sub>6</sub>) are sometimes called high-GWP gases because, for a given amount of mass, they trap substantially more heat than CO<sub>2</sub>. The GWPs for these gases can be in the thousands or tens of thousands. The environmental concern for CFCs follows from their long atmospheric lifetime (55 years for CFC-11 and 140 years for CFC-12, CCl<sub>2</sub>F<sub>2</sub>), which limits our ability to reduce their abundance in the atmosphere.

The primary sources of greenhouse gas emissions are transportation, electricity production, industry, commercial and residential sources.

**Transportation.** The transportation sector generates the largest share of greenhouse gas emissions. Greenhouse gas emissions from transportation primarily come from burning fossil fuel for our cars, trucks, ships, trains, and planes. Over 90 percent of the fuel used for transportation is petroleum based, which includes primarily gasoline and diesel.

Electricity production generates the second largest share of greenhouse gas emissions. Approximately 62.9 percent of our electricity comes from burning fossil fuels, mostly coal and natural gas.

Industry. Greenhouse gas emissions from industry primarily come from burning fossil fuels for energy, as well as greenhouse gas emissions from certain chemical reactions necessary to produce goods from raw materials.

Commercial and Residential. Greenhouse gas emissions from businesses and homes arise primarily from fossil fuels burned for heat, the use of certain products that contain greenhouse gases, and the handling of waste.

**4. Word formation.** Complete the chart. Mark the word stress. Highlight the word suffixes in the third column. Pay attention to the word stress.

Part of speech:	Part of speech:	Part of speech:
		different
absorb		
reflect		
insulate		
	efficiency	
	occurrence	
increase		
	emissions	
	comparison	
	impact	
	estimate	

**5. Vocabulary.** Fill in the gaps in the sentences with the most appropriate word, (a), (b), (c) or (d).

- Earth's surface ..... radiation from the sun.  
(a) emits (b) reflects (c) responds (d) enhances
- Greenhouse gases ..... infra-red radiation in the atmosphere.  
(a) increase (b) reflect (c) absorb (d) stop
- The concentrations of greenhouse gases ..... due to the burning of fossil fuels.  
(a) enhance (b) fall (c) increase (d) decrease
- The ..... global temperature is expected to rise by 1.4 to 5.8 degrees C by the year 2100.  
(a) medium (b) middle (c) average (d) estimated
- A temperature increase of 0.6 degrees C ..... last century.  
(a) enhanced (b) existed (c) rose (d) occurred

**6. Grammar.** Look at the sentences. What verb tenses are used? Why?

Snow cover **has decreased** by some 10 per cent in the mid- and high latitudes of the Northern Hemisphere since the late 1960s.

The annual duration of lake and river ice cover apparently **shortened** by about two weeks during the 20th century.

The text describes changes in extreme weather events. Fill in the gaps using the correct verb forms.

Since 1950, the number of heat waves \_\_\_\_\_ (increase). The extent of regions affected by droughts \_\_\_\_\_ also \_\_\_\_\_ (increase) as precipitation over land \_\_\_\_\_ (decrease) while evaporation \_\_\_\_\_ (increase) due to warmer conditions. Generally, number of heavy daily precipitation events \_\_\_\_\_ (rise), but not everywhere. Tropical storm and hurricane frequencies vary considerably from year to year, but evidence suggests substantial increases in intensity and duration since the 1970s.

**7. Grammar.** Passive and active forms. Look at the examples to learn how the Passive Voice is formed.

*The net effect of the shorter lifetime and higher energy absorption is reflected in the Global Warming Potential (GWP).*

*The GWP was developed to allow comparisons of the global warming impacts of different gases.*

Fill in the gaps in the text using the correct forms of the verbs in brackets.

Forests \_\_\_\_\_ (call) “carbon sinks” because they \_\_\_\_\_ (take) CO<sub>2</sub> from the air and \_\_\_\_\_ (store) it. When trees \_\_\_\_\_ (cut down) and \_\_\_\_\_ (burn), the CO<sub>2</sub> that \_\_\_\_\_ (store) in them \_\_\_\_\_ (release) back into the air. Scientists \_\_\_\_\_ (believe) that every year, 2 billion to 5 billion tonnes of CO<sub>2</sub> \_\_\_\_\_ (release) into the air from forests that \_\_\_\_\_ (cut down) and \_\_\_\_\_ (burn).

**8. Grammar.** Express the same ideas using passive forms. Use the Passive with “by” where appropriate.

a) Scientists first measured atmospheric concentration of CO<sub>2</sub> at the South Pole in 1958.

b) Climatologists use large computer models to estimate future possible warming.

c) The governments signed the Montreal Protocol in 1989.

d) Under the Protocol the industrialized countries stopped CFCs production.

- e) Until the 1970-s people thought that CFCs were absolutely safe.
- f) NASA uses satellites to check the ice in the Arctic region.
- g) Ultraviolet radiation (UV-B) causes mutations in animal and plant cells.
- e) They founded IPCC in 1972.

**9. Reading.** Read the article. Prepare to talk on the following questions.

1. What are two reasons why sea level has risen?
2. Does sea level rise have only social and economic consequences?
3. What does *amplified Arctic warming* mean?
4. What threats can lead to population reduction or even extinction of Arctic animals?
5. Explain why warmer temperatures lead to changes in precipitation patterns.

### **The Effects of Climate Change**

Global climate change has already had observable effects on the environment. Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, plant and animal ranges have shifted and trees are flowering sooner. Effects that scientists predicted would result from global climate change are now occurring: loss of sea ice, accelerated sea level rise and longer, more intense heat waves.

Global sea level has risen by about 8 inches since reliable record keeping began in 1880. It is projected to rise another 1 to 4 feet by 2100. This is the result of added water from melting land ice and the expansion of seawater as it warms. Sea level rise will continue in the 2100s because the oceans take a very long time to respond to warmer conditions at the Earth's surface. Ocean waters will therefore continue to warm and sea level will continue to rise for many centuries at rates equal to or higher than those of the current century.

Rising sea level leads to loss in wetlands and other low-lying lands. Wetlands provide habitat for many species, serve as the basis for many communities' income, and protect local areas from flooding. As the sea rises, the outer boundary of these wetlands will erode, and new wetlands will form inland as previously dry areas are flooded by the higher water levels.

Arctic air temperatures increased by about 5 degrees C during the 20th century - ten times faster than the global surface temperature. The IPCC's Fourth Assessment Report in 2007 summarized the current state of sea ice projections: "the projected reduction [in global sea ice cover] is accelerated in the Arctic, where some models project summer sea ice cover to disappear entirely in the high-emission scenario in the latter part of the 21st century."

The northward shift of the subarctic climate zone is allowing animals that are adapted to that climate to move into the far north, where they are replacing species that are more adapted to a pure Arctic climate. Another concern is the spread of infectious diseases to previously untouched populations. This is a particular danger among marine mammals who were previously segregated by sea ice. Some secondary ecological effects result from the shrinkage of sea ice; for example, polar bears are denied their historic length of seal hunting season due to late formation and early melting of ice. United States Geological Survey completed a year-long study which concluded in part that the floating Arctic sea ice will continue its rapid shrinkage over the next 50 years, consequently wiping out much of the polar bear habitat.

Powerful storms and hotter, longer dry periods are predicted by computer models. Warmer temperatures lead to greater evaporation, and a warmer atmosphere is able to hold more water vapour. So there is more water in the atmosphere that can fall as precipitation. Similarly, dry regions will lose still more moisture if the weather is hotter. This will result in droughts and desertification.

More frequent and powerful cyclones and hurricanes, more frequent and intense floods and droughts are predicted. Scientists say that a recent increase in "extreme weather events" is an indication that climate change already has begun.

Source: <https://climate.nasa.gov/effects/>

**10. Skills development.** Connecting cause and effect. Look at the chart below. It considers some of the projected changes in extreme events and their effects. Write eight sentences relating the facts from the left column with their effects from the right. Use the following words and phrases.

A results in B.	N. As a result M.
B results from A.	N. Therefore M.
A leads to B.	N. Consequently M.
A causes B.	N. This leads to B.
B is due to A.	
A is responsible for B.	

\*A and B are nouns or phrases; N and M are sentences.

Example: *A warmer climate will result in an increase in cooling demand.*

*There will be fewer cold days. Consequently, heating demand will decrease.*

Projected Change	Projected Effects
Higher maximum temperatures; more hot days and heat waves over nearly all land areas	<ul style="list-style-type: none"> <li>• Increase in heat-related deaths particularly among older adults</li> <li>• Increased risk of damage to some crops</li> </ul>
Higher minimum temperatures; fewer cold days, frost days, and cold waves over nearly all land areas	<ul style="list-style-type: none"> <li>• Decrease in cold-related deaths</li> <li>• Decreased risk of damage to some crops and increased risk to others</li> <li>• Reduced heating demand</li> </ul>
Dry regions tend to lose still more moisture if the weather is warmer.	<ul style="list-style-type: none"> <li>• Decrease in water resource quantity and quality</li> <li>• Droughts and desertification.</li> <li>• Increased risk of forest fire</li> </ul>
Increase in tropical cyclone (e.g. tropical storms and hurricanes) rainfall and peak winds over some areas	<ul style="list-style-type: none"> <li>• Increased risks to human life, risk of infectious disease epidemics and other risks</li> <li>• Increased coastal erosion and damage to coastal buildings and infrastructure</li> <li>• Increased damage to coastal ecosystems</li> </ul>

**11. Vocabulary.** Fill in the gaps.

Human-induced warming \_\_\_\_\_ (достигло) \_\_\_\_\_ (приблизительно) 1°C \_\_\_\_\_ (выше преиндустриальных уровней) in 2017, with \_\_\_\_\_ (повышение) at 0.2°C per decade. Global warming is defined as an \_\_\_\_\_ (возрастание) in combined \_\_\_\_\_ (средние) surface air and sea surface temperatures taken over a 30-year period. \_\_\_\_\_ (последствия) of climate change besides \_\_\_\_\_ (возрастающие) temperatures are shifting rainfall patterns, \_\_\_\_\_ (повышение уровня моря), \_\_\_\_\_ (увеличивающееся) ocean acidification, and \_\_\_\_\_ (экстремальные погодные события), such as \_\_\_\_\_ (наводнения), \_\_\_\_\_ (засухи), and heat waves.

**12. Vocabulary.** Put the words in the appropriate column of the chart according to their function.

Decrease, increase, vary, expand, rise, shift, heat waves, fall, severe, heavy, storm, hurricane, considerably, melting of ice, shrink, replace, accelerate, fast, shorten, apparently, cyclone, sufficiently, dramatically, powerful, reduce, dry period.

Verbs describing changes	Adverbs describing the intensity (degree) of changes	Nouns naming weather conditions	Adjectives describing the intensity of weather events
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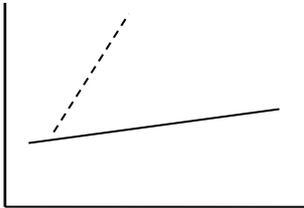
Add some more words to the columns. Use the texts in Ex. 11 and Ex 9.

### 13. Skills development.

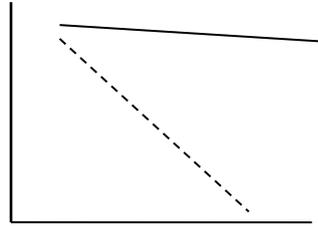
Describing changes and trends. Write the verbs in the Past Simple and the Present Perfect. *Rise, increase, decrease, drop, fall, reduce*

Which trend, (a) or (b) is described in each of the sentences below?

a)



b)



1. ... *has risen/increased (sharply/steadily/sufficiently/dramatically/slightly).*
2. .... *has gone up to ... (number).*
3. *There has been a decrease/drop/fall in ....*
4. ... *decreased over the period from ... to ....*
5. ... *rose over the period from ... to ....*
6. *This graph shows an increase in the number of ...*
7. ... *has fallen/dropped/decreased/reduced*
8. *There has been a/an (slight/sharp/steady/sufficient) increase/rise in ....*
9. ... *has gone down to ... (number).*

**14. Skills development.** Saying figures and years. Match a figure on the left with a word or phrase on the right.

1954	Fifteen degrees Celsius
2005 (year)	Two thousand and five
1905	Nineteen seventy two
50%	A half
10 F	Two thirds
15 C	One hundred and twenty five thousand
125 000	Nineteen fifty four
1972	Ten degrees Fahrenheit
1900 (year)	Fifty percent
2/3	Two point five
2.5	Two point fifty six
2.56	Nineteen hundred
1/2	Nineteen five

**Note the stress!!!** Fifty per'cent

Say the numbers: 560, 45 980, 450 000, 500 000, 560 000, 351 670, 56.25, 33.33 %, 4.9, 1/3.

**15. Skills development.** Find statistics on the following subjects. Greenhouse gas emissions, sea level rise, deforestation. Comment on the changes and the effects of the changes.

## Unit 4

### Natural Resources

#### **1. Introduction. In pairs choose the best answer to each question.**

1. What is the key difference between exhaustible and inexhaustible resources?
  - a. All exhaustible resources pollute the environment; inexhaustible resources don't.
  - b. Exhaustible resources need to be refined before humans can use them; inexhaustible resources don't.
  - c. Exhaustible resources exist in unlimited quantities; inexhaustible resources don't.
  - d. Inexhaustible resources exist in unlimited quantities; exhaustible resources don't.
2. Solar energy is considered a sustainable energy source. What does "sustainable" mean?
  - a. Capable of being continued long-term
  - b. Available to everyone
  - c. Related to light and heat
  - d. Related to the sun
3. Coal, petroleum, natural gas are fossil fuels. They are called so because ...
  - a. they are burned to release energy and they cause air pollution
  - b. they were formed from the remains of plants and tiny animals that lived hundreds of millions of years ago
  - c. they are exhaustible and will run out
  - d. they are mixed with fossils to provide energy

#### **2. Vocabulary.** Translate the words without using a dictionary.

resources, factor, services, minerals, energy, kerosene, petroleum, basic, electrical, thermal, chemical, kinetic, potential, nature, characteristics, to conserve, to recycle.

#### **3. Vocabulary.** Explain the principles of forming the following words. What parts of speech are they?

Inexhaustible, wildlife, isolated, unevaluated, costly, overhunting, rising, disadvantage, recycle.

#### **4. Vocabulary.** Translate word combinations using a dictionary.

to meet basic needs, in the same way, to supply (somebody or something) with goods and services, to find it possible, to gain value, to replace some resources, to seek substitutes.

**5. Vocabulary.** Match words close in meaning (synonyms) from **a)** and **b)**.

**a)** to affect, isolated, to apply, to view, to convert, advantage, to seek, to satisfy needs;

**b)** to regard, to influence, to meet needs, advance, to look for, to change into, to use, desolate.

**6. Vocabulary.** Give synonyms for the following words (more than one if possible): to occur, to regard, to produce, costly, to seek, to replace, demand, cheap, wildlife, desolate, to gain.

**7. Vocabulary.** Give antonyms for the following words: costly, exhaustible, renewable, cheap, advantage, desolate, useful, different, scarce.

## **8. Reading.**

**Pre-reading task.** Answer the following questions:

1. What natural resources do you know?
2. How do people use natural resources?
3. What natural resources do you use in your life?

### **Words and phrases to remember**

natural resources	goods and services	to seek
to contain	to exist	to look for
to make use of something	source	to supply
to satisfy (to meet) needs	to gain value	to regard
to occur	to conserve	substitute (n) for
exhaustible	nuclear energy	scarcity
whether	to convert/ to change into	costly
uranium ores	to affect	to replace

Read the text and complete the tasks in **Comprehension check** below the text.

### **The Earth's Resources**

On the Earth there are a lot of natural resources which help people satisfy their needs and wants. Natural resources –naturally occurring materials that can be used to produce goods and services – exist as a part of the environment and are an important part of an area's characteristics. The natural resources are divided into exhaustible and inexhaustible. The difference between exhaustible and inexhaustible is extremely important. If an exhaustible resource is not conserved, it ultimately disappears.

Among the resources there are not only minerals, soil, water, forests, and wildlife, but also air and the energy of the sun which people know how to make use of. People convert them into useful machines, tools and foods. Even the most desolate and isolated areas of the world contain at least some resources or materials that people use to meet basic needs.

Not all people in the world use natural resources in the same way. There are some factors that affect the use of natural resources: cultural differences, technological change, economic factors, and others. People in different times and places may have different ideas about whether something supplied by nature can be used as a natural resource. Technological changes make it possible to use previously unevaluated natural resources. In the 1700's people did not use uranium ores and did not find them to be useful resources. Uranium gained value only after modern advances which were able to show its advantage as a source of nuclear energy.

Besides, there are economic factors that influence the way people use natural resources. Scarcity and rising prices have always led people to seek substitutes for costly resources. In colonial days, for example, people burned whale oil for lighting. As demand for whale oil rose, more and more whales were hunted. Eventually overhunting made whales harder to find and prices rose. As a result, people looked for cheaper substitutes. In time they found a way to make kerosene from petroleum. Because kerosene cost less than whale oil, it quickly replaced whale oil as a lighting fuel.

### **Comprehension check**

A. Answer the questions.

- a) Why are natural resources important?
- b) What is the difference between exhaustible and inexhaustible resources?
- c) What factors affect the value and use of natural resources?
- d) How do technological advances and economic factors change the way people meet their needs?
- e) What happens if a resource becomes rare and expensive?

B. What is the main idea of each paragraph of the text? Think of a title for each paragraph.

C. Put at least one question to every paragraph of the text.

D. Translate the text.

**9. Vocabulary.** Make nouns from the following verbs:

to concentrate, to exist, to deposit, to change, to demand, to locate, to use, to expect, to discover, to resist, to forecast.

**10. Vocabulary.** Match the verbs from **a)** with the nouns (or phrases) from **b)** to make word combinations.

**a)** to meet, to produce, to convert, to gain, to have demand for, to find, to replace, to look for, to affect, to regard, to use;

**b)** natural resources, materials into tools and food, whale oil, value, the use of resources, goods and services, fuel, a substitute, in the same way, a way, needs.

**11. Vocabulary.** Pay attention to the prefix **over** in the words below. What does it mean? Translate the words.

Overuse, Overconsumption, overpopulation, overexploitation, oversimplifying, overfertilizing.

**12. Vocabulary.** Fill in the gaps with necessary propositions.

1) A natural resource's value is based ... the amount of the material available and the demand ... it.

2) Developed nations are those which are less dependent ... natural resources ... their wealth, due ... their greater reliance ... production.

3) Both extraction ... the basic resource and refining it ... a purer, usable form are considered natural-resource activities.

4) Resources can be classified ... basis ... their origin as biotic and abiotic.

5) Fossil fuels, ... example, take millions ... years to form and so are not considered renewable.

6) Many environmentalists proposed to tax ... consumption ... non-renewable resources.

7) High prices have always caused people seek substitutes .... costly resources.

**13. Vocabulary.** Translate the word combinations into English:

удовлетворять потребности, экономические факторы, искать заместители, производить товары и услуги, приобретать ценность, рассматривать как, неисчерпаемые ресурсы.

**14. Vocabulary.** Try to explain the following words and word combinations in English.

natural resources, exhaustible resources, to recycle resources, economic factors, advantage of some material, find substitutes for a resource, overuse.

**15. Vocabulary.** Put the words given below into the gaps.

Man is the most highly evolved animal that has always been dependent on ... . The development enabled him to identify materials of nature and ... them for his

comfort. He converted most of the natural ... for his own interest. This was possible later, when development and technological .... allowed to transform these natural sources into .... goods. Thus, natural resources can be defined as .... of the nature, that can be used by human beings for their development, comfort and to meet their ..... At present, total global production is nearly enough to satisfy the human ... for energy and materials. Now the boundaries of .... are from polar ice to equatorial mountain tops and from deep ocean to ionosphere of sky. Everything which is ... in this environment is ... as natural resource.

**Words to put into the gaps:** materials, environment, valuable, regarded, nature, resources, needs, demand, available, advance, to use.

**16. Skills development.** Give a summary of the text about natural resources (Ex. 8) using the following word combinations.

to satisfy needs and wants, naturally occurring materials, exhaustible resources, to convert into useful things, to affect the use of, to regard the area, unevaluated resources, to gain value, economic factors, to seek substitutes (for), costly resources.

**17. Grammar: ways to translate THERE IS (ARE).** Translate the sentences.

- 1) There is a growing concern over the protection of species habitat and biodiversity.
- 2) There have been many reports about deforestation which is destroying large areas of tropical rain forests.
- 3) There was no mistaking the pride with which he spoke about the success of their project.
- 4) There have been no experiments done in the marine environment that are equivalent to those done in the Mediterranean.
- 5) There would be problems if there were more rain.
- 6) There seems to be a lot of sense in his suggestion.
- 7) There is no possibility to stop the progress in industry.
- 8) There are no problems of pollution associated with solar energy use, except those related to the devices that may be used to capture or transport this energy.
- 9) On occasion in borders of parks there can be land areas of other users and also proprietors.
- 10) Since the heat and energy is collected during the warm seasons and used during the cold seasons, there must be a way to collect that energy efficiently.

**18. Grammar: THERE IS (ARE).** Translate the sentences into English.

- 1) Существует постоянный поток энергии на поверхность и с поверхности Земли.

- 2) Есть несколько видов ископаемого топлива, которые являются исчерпаемыми источниками энергии. Это означает, что, когда они израсходуются, их невозможно будет заменить.
- 3) Наблюдается чрезмерное потребление энергии, воды и сырья, что в результате приведет к загрязнению воздуха.
- 4) Происходит выделение неразлагающихся продуктов, которое добавляет загрязнение в атмосферу.
- 5) Есть и другие ресурсы, которые рассматриваются как неисчерпаемые, например, солнечная энергия.
- 6) Во всем мире ведутся обсуждения по поводу распределения природных ресурсов, и это особенно важно в период растущего дефицита (scarcity).

**19. Skills development.** Ways to explain complicated concepts. Make full sentences.

Sustainable development <u>means</u>	as it is stable and available in plenty.
Solar energy <u>is considered</u>	that people meet their needs without destroying the environment.
Solar energy <u>is referred to</u> as sustainable energy source	as a renewable resource. People replant trees.
Forests <u>are regarded</u>	a sustainable energy source.

Talk about wind energy as an inexhaustible energy source.

Talk about oil and coal as an exhaustible fossil fuels.

## Unit 5

### Mineral Resources and Energy Today and Tomorrow

**1. Introduction.** There are definitions of different kinds of energy. Which of them can be mentioned when we talk about alternative energy sources? Explain how they are connected with this topic.

2) Kinetic energy is the energy an object has due to its motion.

3) Potential energy is the energy stored in any object because of its position. It is called *potential* energy because it has the potential to be converted into other forms of energy, such as kinetic energy.

4) Thermal energy is the energy all objects have and it increases as the temperature increases.

5) Chemical energy is the energy stored in the bonds between atoms; the energy is released when bonds are broken.

- 6) Radiant energy is the type of energy that light carries, light can be absorbed, reflected or transmitted to another object.
- 7) Electrical energy is energy carried by electrical current that is generated at large power plants.
- 8) Nuclear energy is energy contained within the nucleus of an atom. There is enormous energy in the bonds that hold atoms together.

**2. Vocabulary.** Translate the words without a dictionary:

minerals, concentration, technological, prospects, materials, civilization, location, transportation, synthetics, equivalent.

**3. Vocabulary.** Give synonyms for the following words: to foresee, to extract, short-term future, to go up, to exhaust, to shift, internal, scarce, increase, essential.

### Words and phrases to remember

under economic conditions	to run into conflict	to take into account
	mineral deposits	to exhaust
to foresee	to go up (about price)	To pay attention to
to extract	to increase	ore
short-term future	available supplies	standard of living
it follows	to shift from ... to	demand for smth

### **4. Reading.**

**Pre-reading task.** Look at the title. What issue do you think the article raises? Read the text and answer the questions below the text.

### **Mineral Resources and Energy Today and Tomorrow**

A deposit of any minerals is known as an ore, if the mineral is present in such concentration and quantity that it can be extracted profitably under the technological or economic conditions which exist or can be foreseen for the short-term future. It follows that certain mineral deposits which are not ores today will be the ones tomorrow if prices go up, technology changes or demand rises.

It is impossible, therefore, to speak with accuracy about the supplies, demands or future prospects for any nonliving materials used in technological civilization. First, we don't know the location of all available supplies. Each year brings new discoveries, and often they are of great quantities. Second, we don't know what demands can be expected in future. If we shift from automobiles as they now exist –

and obviously we must – to other vehicles or means of transportation, then demands for some metals (e.g. batteries for electric cars) may go up, while demands for the heat-resistant metals used in “high-temperature” internal combustion engines will go down.

Attempts to forecast the future is to run into the conflict between technological optimists and pessimists. Some believe that new discoveries, the development of new synthetics and composites, more efficiency in production, and substitution of plentiful for scarce materials will keep supplies of essential materials available into the indefinite future. However, a great number of more pessimistic viewpoints deserve some attention. They take into account not only present demand, but also the steady increase in demand that has now gone on for several decades. They also pay attention to the change in the demand picture if all nations are brought to a high standard of living and there are requirements equivalent to the modern industrialized world. From these point of view there is no doubt that all known supplies of many minerals will be exhausted before the end of the century.

Answer the questions on the text.

1. What is known as an ore?
2. Why is it impossible to speak with accuracy about the supplies, demands or future prospects for any of the non-living materials?
3. What conflict is there between optimists and pessimists?
4. What is the pessimistic viewpoint on mineral resources use in future?
5. What is your opinion on the problem and what side do you take?

**5. Vocabulary.** Give Russian equivalents for the following word combinations: mineral deposits, means of transportation, heat-resistant metals, high-temperature internal combustion engine, demand and supply, scarce materials, concentration and quantity, under economic conditions, technological civilization, available supplies, synthetics and composites.

**6. Vocabulary.** Give the definition of the English terms: mineral deposit, potential reserves, means of transportation, natural resources, nonliving materials, composites.

**7. Vocabulary.** Find as many derivatives as you can to each of the words: concentration, probability, economic, profit, increase, recycle, efficiency.

**8. Vocabulary.** Cross out an odd word in each line. Number each line according to the headings given below.

coal	oil	natural gas	wind
sun	wind	fossil	geothermal
iron ore	copper	sun energy	fossil fuel
abundant	scarce	exhaustible	fragile
overloading	overharvesting	overheated	overexploiting

**Headings:** 1) Overuse of something; 2) Non-renewable natural resources; 3) Renewable resources; 4) Resources that can be depleted; 5) Kinds of energy.

**9. Vocabulary.** Match the words from A with the words from B to form word combinations.

1) A: decayed, electric, economic, hazardous, resource, fossil, mineral, natural

B: deposit, gas, waste, fuel, plant, factor, depletion, power;

2) A: to gain, to meet, to manufacture, to raise, to prevent, to generate, to preserve, to forecast

B: value, natural habitat, future, oil resources, electricity, goods, erosion, basic needs

**10. Vocabulary.** Complete the sentences with suitable words given below.

1. Materials people use to meet basic needs are called ....
2. A ... can be replaced naturally and used over and over again.
3. A ... is an inorganic substance in the earth's crust, such as gold and iron ore.
4. ... is the soil layer that consists of decayed plants and animals.
5. ... makes it possible to reuse products that have been used discarded.
6. A person who works to protect natural resources is ....
7. ... are oil-based materials.
8. An energy source that has been formed from the remains of plants and animals died millions of years ago is known as a ...

**Words to insert:** plastics, resources, mineral deposit, ecologist, non-renewable resource, renewable resource, fossil fuel, recycling.

**11. Vocabulary.** Try to explain in English the following expressions: to run into conflict, to run somebody into conflict, to extract profitably, to foresee the future, to keep something available, to take something into account, to pay attention, to bring something to high standards.

**12.** Fill in the gaps with suitable propositions.

1. It is impossible to speak ... accuracy ... the supplies, demands or future prospects ... any ... the nonliving materials used ... technological civilization.
2. The mineral resources ... the ocean floor are going to receive great attention ... future as the technology ... mining them becomes available.
3. They take ... account not only the needs ... the industrialized nations today, but also the change ... demand picture if all nations are brought ... a high standard ... living.
4. ... the same time most developing countries ... rapid population growth face the urgent need to improve their standards ... living.
5. We live ... the period ... greatest extinction ... plant and animal species. Two ... every three species are estimated to be ... decline.
6. ... contrast ... the previous extinctions which were due ... the change ... climate and sea level, the last one has begun because ... humanity's gross misuse ... the earth's resources.

### 13. GRAMMAR: MODALS

Put suitable modals into gaps (can, could, may, must, to be to, to have to).

1. Mineral reserves constitute those ores that are known to exist or ... be expected to exist at a high probability.
2. If we change automobile for other means of transportation because we obviously ..., the demand for some metals ... rise.
3. New discoveries and improvements in technology .... affect both demand and supply.
4. The attempt to forecast the future ... run into the conflict between technological optimists and pessimists.
5. The wire may also be made of any metal though soft metals .... to be avoided.

**14. GRAMMAR.** Translate the sentences paying attention to the words **in bold**. Put them into negative and interrogative forms if possible.

1. They **were able to** seek the profit without too much concern for its future effects.
2. To make shale oil (сланцевая нефть) available, great amounts of water **have to** be provided to operate the processing plants, if oil shale occurs where water is scarce.
3. Greenpeace estimates that no more than 225 billion tons of carbon **can** be burned if global warming **is to** be limited to the increase of 1 degree Centigrade.
4. Some environmentalists argue that governments **should** ban all production of CFC immediately to prevent an irreversible environmental crisis.
5. It **should** be clear that sustainability of human society as well as sustainability of other species will depend on maintaining the integrity of the biosphere.

6. To support the integrity of the biosphere we **need** to know how the biosphere functions to support all life.

7. One **should** remember that environmental health is of great importance for all people in the world, that's why whole mankind **must** be responsible for the ecology.

8. It is supposedly going to be a costly affair **to finally be able to** develop a method to produce energy from tides.

9. Hydroelectricity can be easily produced; all we **have to** do is construct a reservoir, store water in it and manipulate its movement and flow.

10. **Not having to** pay for resources does not make it free, it simply reduces the price of producing energy.

11. If you want to commit yourself to a renewable energy source, you **may have to** learn more about that. Also, you **have to** know that there are several types of renewable energies and before you decide to use one (or multiple) energy source, you **must** first dig a bit deeper into this sphere.

12. Whatever bit of maintenance is required, it is required for maintaining the equipment with which the alternative energy **is to be** harnessed.

13. If you want to commit yourself to a renewable energy source you **may have to** learn more about that.

**15. GRAMMAR.** Read the instructions and translate them. Explain use of the modals.

**Batteries to store your energy.** You **must** use a special type called deep cycle batteries. These are capable to discharge a smaller amount of energy and still keep a long life. They **need** special maintenance and they won't last you a lifetime – you **must** replace them every few years.

Backup (резервный) generators. These **are to be** used when your energy income is low. This means that you will actually **have to** acquire the generator and the necessary fuel and make sure that it **can** support your entire household for at least a few days.

Only the idea of living completely off the grid and not be dependent of a national system that charges you every month with overpriced energy **should** be a pretty strong motivation.

**16. GRAMMAR.** Choose the proper modal verb:

1. можно найти (must, may, can) be found
2. нужно использовать (may, must, can) be used
3. нельзя поймать (may not, cannot, can) be caught
4. нужно сохранить (can, may not, must) be preserved

5. можно доказать (can, may, must) be proved
6. нельзя сгруппировать (must not, can, cannot) be grouped

**17. GRAMMAR: MODALS PLUS PRESENT PERFECT.** Translate the sentences into Russian and explain the use of Present Perfect after modal verbs.

1. Increased volcanic activity in the late 18<sup>th</sup> and early 19<sup>th</sup> centuries produced dust wells in the upper atmosphere which **may have prolonged** the cold spell.
2. The broken and contorted chromosomes that appeared under researchers' microscopes **might have been exposed** to radiation.
3. Windmills **must have been used** for centuries to grind grain and pump water.
4. There **could have been** several alternative energy projects running in various countries to reduce our dependence on traditional fossil fuels.
5. Newton **couldn't use** present day technologies. He **had to rely** on observation. He **must have been influenced** by the data available at his time. He might have been mistaken.

**18. GRAMMAR: MODALS PLUS PRESENT PERFECT.** Fill in the spaces of the text with phrases (modals plus Present Perfect) given below. Translate the text.

### **EASTER ISLAND**

Easter Island, 3,000 km off the coast of Chile in the Pacific Ocean, is very far from land. Today, it is a small island with few people or trees, but at one time a lot of people lived there. Scientists believe that the original inhabitants .... the island by accident. Around 100 people .... on the western coast of the island. But then the number of inhabitants increased too quickly. Scientists agree that the inhabitants .... all the food on the island and finally all died. The Easter Island statues are famous, but nobody knows why they are there or why there are so many. The statues ... gods, or Easter Island ... part of a much bigger island. The statues are very large and heavy, so they ... easy to move. Scientists still do not know how the inhabitants ... this.

**Phrases to put into spaces:**

- may have landed
- might have done this
- must have used up all the food
- can't have been easy
- may have discovered the island
- could have been part
- might have been gods

### 19. Translate the sentences into English.

1. Залежи минералов могут считаться рудой, если минерал присутствует в них в такой концентрации и количестве, что может добываться с прибылью в данных экономических условиях.

2. Все большее внимание в будущем будет уделяться ресурсам дна Мирового океана, так как добыча их становится доступной благодаря улучшениям технологий.

3. Пессимистические прогнозы учитывают не только потребности промышленно развитых стран в настоящее время, но и изменения спроса в будущем, когда все страны будут иметь высокий уровень жизни.

4. Оптимисты считают, что современные открытия, разработка новых синтетических материалов и композитов и замещение редких ресурсов будут поддерживать запасы важных материалов доступными.

**20. Grammar revision: there is (are).** Translate the sentences into English using the following words and expressions: renewable and non-renewable resources, replacement rate, amount of stock, living and non-living factors, environmentalists, to tax on consumption, to deplete, whether, deposits of minerals.

1. В природе существуют как возобновляемые, так и невозобновляемые ресурсы. Интенсивность использования возобновляемых ресурсов определяется темпом их восстановления и количеством их запасов.

2. В окружающей среде есть биотические (растения, животные, микробы) и абиотические (земля, вода, воздух) ресурсы. Это деление зависит от того, являются ли они живыми или неживыми факторами окружающей среды.

3. Есть много сторонников бережного отношения к природе, они предлагают ввести налог на потребление невозобновляемых ресурсов.

4. Нет сомнений, что большинство известных запасов многих минералов будут истощены еще до конца века.

**21. Skills development. Speaking.** Look through the text in Ex.4 again. Make up a list of arguments under the headings:

a) technological optimists

b) technological pessimists

Use short notes. Add your own arguments. Then looking at your notes explain why you are a technological optimist (or pessimist).

## Unit 6 Nuclear Energy

**1. Introduction.** Discuss the questions.

1. What are the advantages and disadvantages (pros and contras) of nuclear power? 2. Why do some countries remain nuclear-free?
3. Do you know if there are any nuclear power stations in the place where you live?
4. Do you think it is true that nuclear reactors supply about 15% of all electricity generated in the world?
5. Will the share of nuclear energy in the world's electricity production will rise in the long-term future?
5. What accident (accidents) has led people to question the wisdom of building and using nuclear power plants?
6. Are there any possible ways to replace nuclear power?
7. How many electrical appliances have you got at home? Are there any you can do without?

### Words to remember

nucleus (pl. nuclei)	to sustain	to melt
to bind (bound)	self-sustained	explosion
to associate	even	chain reaction
attractive	to release	devastating
to combine	to cause	to develop
fusion/fission	to prove (оказываться)	to involve
to split	to lead (to)	to run (generator)
to supply	to convert	steam
to consume	to carry out (research)	to generate (energy)
quantity	coal-burning power	break-u
relative(ly)	plant	

**2. Reading.** Look at the information about accidents at spent nuclear fuel treatment facilities. Which ones did you know about? Which one had the most serious consequences?

### **Some Major Accidents at Spent Nuclear Fuel Treatment Facilities**

1957. USSR. The worst disaster is considered to be the one at the Mayak plant which was kept under strict secrecy at the time. Up to this day people are dying as a result of the accident which contaminated the local water reservoirs and air.

1977. Cape La Hague, France. Block depressurization. France assured that there had been no radioactive emission. But Greenpeace discovered high levels of radiation in territorial waters.

1978. Idaho, United States. Spontaneous chain reaction. No radiation emission. No victims.

1979 and 1983. Sellafield Plant, England. The first incident involved a radiation leak, and the second, radioactive contamination of the soil, and a radioactive leakage into the sea.

1986. Ukraine, USSR. The Chernobyl nuclear disaster began early on Saturday 26 April within the Chernobyl Nuclear Power Plant. An explosion and fire released large quantities of radioactive contamination into the atmosphere, which spread over much of Western USSR and Europe. It is considered the worst nuclear power plant accident in history and is one of only two classified as a level 7 event on the International Nuclear Event Scale (the other being the Fukushima nuclear disaster in 2011).

- 3. Reading.** Read the text and answer the questions in **Comprehension check** below. Translate the text.

### **Nuclear Energy**

**1.** The protons and the neutrons in atomic nuclei are bound together with forces that are much greater than the forces that bind atoms together to form molecules. In fact, the energies associated with nuclear processes are more than a million times those associated with chemical reactions. This potentially makes the nucleus a very attractive source of energy. There are two types of nuclear process producing energy:

a) Combining two light nuclei to form a heavier nucleus. These processes are called fusion.

b) Splitting a heavy nucleus into two nuclei with smaller mass numbers. This process is called fission.

Both processes can supply amazing quantities of energy with relatively small masses of materials consumed.

**2.** Nuclear fission was discovered in the late 1930s when U-nuclides bombarded with neutrons were observed to split in two lighter elements. In order for the fission process to be self-sustained, at least one neutron from each fission event<sup>1</sup> must go on to split another nucleus. Neutrons released from the break-up of one nucleus bombard other nuclei, causing a chain reaction which leads to sudden, explosive release of energy. This is the basis of both nuclear weapons and nuclear power in which energy of nuclear fission is converted to electricity.

During World War II the United States carried out an intense research effort called the Manhattan Project to build a bomb on the principles of nuclear fission. This programme produced the fission bomb which was used with devastating effect on the cities of Hiroshima and Nagasaki in 1945.

3. The process of combining two light nuclei called nuclear fusion produces even more energy than nuclear fission does. In fact, stars produce their energy through nuclear fusion. Our sun which consists of 73% hydrogen, 26% helium and 1% other elements gives off vast quantities of energy from the fusion. In nuclear fusion two nuclei join together: the protons and the neutrons combine to form a larger nucleus, some protons, neutrons and other particles escape, and energy is released. Intense efforts are under way to develop a feasible fusion process, however, initiating the fusion processes is much more difficult than initiating fission. Currently, scientists are studying two types of systems to produce the extremely high temperature required. But still many technical problems remain to be solved, and it is not clear whether either method will prove useful.

4. Because of the tremendous energy involved, fission has been developed as an energy source to produce electricity in reactors where controlled fission can occur. The resulting energy is used to heat water to produce steam that runs turbine generators, in much the same way that a coal-burning power plant generates energy by heating water to produce steam. Although the concentration of  $^{235}\text{U}$  in the fuel elements is not great enough to allow an explosion such as the one that occurs in a fission bomb, a failure of the cooling system can lead temperatures high enough to melt the reactor core. This means that the building housing the core must be designed to contain the core even in the event of such a melt-down. A great deal of controversy appeared about the efficiency of the safety in power plant systems. Accidents such as the one in the Three Mile Island facility in Pennsylvania in 1979 and the one at Chernobyl in the Soviet Union in 1986 have made people to doubt in the wisdom of building fission-based power plants.

<sup>1</sup>fission event - акт деления

### **Comprehension check**

A) 1. Which forces can be observed in nuclear processes?

2. Which reaction produces more energy if you compare nuclear and chemical ones?

3. What makes the nucleus a very attractive source of energy?

4. What types of nuclear process produce energy?

5. What is needed for a chain reaction to take place?

6. What principle does a nuclear reactor depend on when it is in operation?

7. What problems do scientists have to solve for safe operation of the reactor?

8. What is the difference between fusion and fission?

**B)** Choose the statement that best expresses the main idea of the paragraph:

**Paragraph 1.**

1. Nuclear power may be produced in the course of a chain reaction.
2. There are two types of nuclear processes that produce energy: fission and fusion.
3. The energies released by nuclear processes are more than a million times greater than those associated with chemical reactions; there are two types of nuclear processes (fission and fusion) that produce energy.

**Paragraph 2.**

1. Nuclear fission was discovered in the late 1930s.
2. A chain reaction, which leads to a release of energy, is the basis of both nuclear weapons and nuclear power.
3. Nuclear fission is the process in which nuclides of certain heavy metals can be split into lighter elements with a release of great amount of energy. Nuclear weapons and nuclear power work on principles of nuclear fission.

**Paragraph 3.**

1. Nuclear fusion is the process of combining two light nuclei with a release of huge quantities of energy even more than in the process of nuclear fission.
2. Stars produce their energy through nuclear fusion.
3. A thermonuclear bomb works on the principle of nuclear fusion.

**Paragraph 4.**

1. Fission-based power plants are used to heat water to produce steam that runs turbine generators, in much the same way that a coal-burning power generates energy.
2. A great deal of controversy now exists about the safety of the systems in power plants.
3. There are different types of fission-based power plants provided with the safety systems but accidents occur and much controversy surrounds the use of nuclear energy to generate electricity.

**4. Vocabulary.** Match the verbs in column A with the nouns in column B to make phrases.

A	B
To cause	harmful radiation
To carry out	heavy nucleus
To run	neutrons
To consume	electric generator
To run	electricity

To combine	research
To produce	two nuclei
To split	materials
To absorb	chain reaction

**5. Vocabulary.** Complete the sentences with the following words: chain, generations, fusion, break-up, threat, harmful.

1. There two types of nuclear reactions: fission and ... .
2. Natural radioactive decay does not normally release much energy because the nuclei ... very slowly, sometimes over hundreds of years.
3. A nuclear ... reaction can result if neutrons from each fission cause more nuclei to split.
4. Nuclear power stations are a potential source of ... radiation.
5. Genetic damage is damage to the genetic mechanism of the organism which will be manifested in future ... .
6. The use of the nuclear fuels could lead to the pollution of the environment or a dangerous terrorist ... .

**6. Vocabulary.** Match two words that are synonyms: to separate, to start, to combine, to change into, to bring about, to split, to find out, to observe, to result in, to discover, to cause, to convert, to lead, to initiate, to join, to watch.

**7. Vocabulary.** Give antonyms for the following words. All the opposites can be found in the text above.

to combine, to supply, to release, to connect, to receive, to destroy, to increase, to heat, to contaminate, light.

**8. Vocabulary.** Put the words given bellow into the gaps. Pay attention to the modal verbs used.

### **Nuclear Problems**

There are two approaches to the nuclear waste. One is ... the waste either on the surface or underground. If the ... is kept for long enough, the radioactivity drops to safe levels. In some cases, it **has to** be stored for thousands of years. The problems of handling and ... of highly ... waste **can** be reduced if it is sealed in concrete or glass blocks before ... . After long period materials such as glass or concrete **may** ... because of weathering and corrosion. This problem **has to** be controlled and ... if it arises.

Another ... to the problem is ... the waste to the environment so that it gets diluted in the sea or in the air. This **must** be done only in the case of .... waste that will not significantly affect the environment.

The problem of the ... waste still remains to be solved and requires further .... . The use of nuclear ... **could** lead to pollution of the ... or a dangerous terrorist ... .

**Words to insert:** radioactive, solved, to store, low-activity, environment, threat, deteriorate, to release, approach, nuclear, investigation, storing, waste, storage, fuel.

**9. Word formation.** What parts of speech are the following words?

to store – storage – storing – stored; to approach – approaching – approached – approach; to reduce – reduce – reducing – reduction – reduced; to depend – depending – dependent – dependence – depended; to recycle – recycled – recycling.

**10. Vocabulary.** Insert the following words into the gaps: hydrogen, waste, to produce, cheap, to develop, amounts, united, fusion, energy.

### **Nuclear Fusion**

Fusion may solve all our .... problems. Atoms of hydrogen are .... and can produce large .... of energy. In contrast to the splitting of atoms, .... is safer and does not produce a lot of nuclear ... .

We have an almost endless amount of .... in our oceans but, up to now, scientists have not yet decided on a way .... large amounts of such energy. Such a system, which produces .... energy from our oceans, will probably take years or decades to .....

**11. Skills development.** Translate the text into English using words and word combinations from the texts above.

### **Ядерная энергия**

Энергию можно получить от расщепления атомных ядер (ядерное расщепление) или объединения ядер атомов (ядерное слияние). В каждой из этих реакций выделяется большое количество энергии. Атомные станции используют устройство, называемое ядерным реактором, в котором атомы урана или плутония расщепляются в контролируемой реакции расщепления. Выделяемая тепловая энергия накапливается и используется для того, чтобы выработать электричество. Что касается 2000 года, то в США было 110 действующих атомных станций, а во Франции 70% производства электричества основано на атомной энергии. Как считают многие ученые, контролируемая ядерная реакция – это окончательная решение проблем мировой энергии. Энергия, выделяющаяся в реакции слияния, во много раз больше, чем энергия, выделяющаяся в реакции расщепления. Сегодня, однако, эта технология еще не разработана для того, чтобы можно было воспользоваться этим источником энергии.

**12. Skills development.** Discuss the questions.

1. What is your personal opinion on the use of nuclear power?
2. Why has Chernobyl accident led some countries to refuse from building and using nuclear power?
3. Do you think the world could do without nuclear power? Are there any alternative energy sources?
4. Can we hope that new sources of energy will be discovered in future as a result of intensive research?
5. Why do many countries still continue to use nuclear power?

**13.** Make a report on nuclear energy. Give your arguments in favour and against it. What is your opinion on the future of nuclear energy?

## **14. GRAMMAR: CONDITIONALS**

**A) Zero Conditionals.** Translate the sentences into Russian.

1. If a piston (поршень) moves up, the pressure in the cylinder increases.
2. If your area receives a great deal of direct sun light, a solar system will provide electricity and heating for your home.
3. If the sun is not shining, the solar power is not producing energy.
4. If everything is done correctly, geothermal energy produces no harmful by-products.
5. If wind speed decreases, the turbine lingers and less electricity is generated.
6. Fortunately, it is easier to improve the energy performance of new buildings and improvements can often be made for a much lower cost if they are taken into account early enough in the design process.
7. If alternative energy is children's reality right from the start, it will not be a challenge for them to adjust to these options later in life.

**B) Conditionals I.** Translate the sentences into Russian.

1. Unless we have safe containers, we will not be able to dispose of toxic waste.
2. If the temperature rises above 1000°C, the boiler will explode.
3. If reductions of CO<sub>2</sub> emissions are to be achieved, we'll have to reduce the energy used in buildings significantly.
5. If you teach your children the value of using energy conservation practices, it will benefit them their entire lives.
6. If your power company allows it, you will be able to connect the system to the grid and sell the excess energy to the company.

**C) Conditionals II.** Translate the sentences into Russian.

1. If natural resources were valued in the same way that manufactured assets are valued, it might help economists learn to use them more effectively and to conserve them in order to assure continued use in future.
2. If it weren't for the protective nature of the atmosphere, the sun would "fry" us with its high-energy radiation.
3. If every nuclear plant were closed down tomorrow, the world would still be living with the legacy of nuclear power for the next 500 years.
4. If wind power as another alternative energy source could be used on a massive scale, there would not be production of by-products that are harmful for nature.
5. But for large-scale support for research in Universities, the flow of technical advances needed to maintain our living standards would be severely damaged.

**D) Compare Conditionals I and II.**

- 1.a) If we don't employ fossil fuels in the production of electricity, these materials will be used to manufacture other valuable things.
- b) If we didn't employ fossil fuels in the production of electricity, these materials would be used to manufacture other valuable things.
- 2.a) If more people use public transport, it will be possible to park your car in the city center.
- b) If more people used public transport, it would be possible to park your car in the city center.
- 3.a) If we develop other alternative sources, fossil fuels won't run out so rapidly.
- b) If we developed other alternative sources, fossil fuels wouldn't run out so rapidly.

**15. GRAMMAR: CONDITIONALS.** Complete the Conditionals II with the proper verb forms.

1. If environmental problems (not affect) people daily, they (not be) concerned about protecting the natural world.
3. If changes in climate and weather (happen) faster, natural vegetation (can not) adapt to them.
4. If emissions of greenhouse gases (be) cut to 60-80 per cent, the Earth climate (stabilize).
5. We (can) develop other alternative sources if we (spend) more money on research.

**16. GRAMMAR: CONDITIONALS.** Translate the sentences into English.

1. Если бы каждый в развивающихся странах использовал такое же количество энергии, что и средний потребитель в странах с высоким доходом, потребление энергии в развивающихся странах увеличилось бы в 8 раз.

2. Даже если бы проблема ядерных отходов была решена, общественное беспокойство о безопасности ядерной энергии не исчезло бы.
3. Если бы ядерные станции не были так важны для обеспечения электричеством, то было бы много аргументов в пользу их закрытия.
4. Если бы не энергетическая проблема, не пришлось бы строить атомные станции.

## Unit 7 Natural Gas

### Words to remember

replacement	wellhead	pipeline system
to be precise	(месторождение)	to inject
to liquefy	oil field	due to technological
liquefied gas	(месторождение	advance
to surpass	нефти)	to disperse
recent(ly)	to run on oil	to attract investment
crude oil	reserves (запасы)	to contain
underground reservoir	impurities	to consist
methane	waste – to waste	to process
hydrocarbon	to draw attention (to)	reservoir (a trap
compounds	well	underground where
oil field	at great expense	gas concentrates)
	to put simply	

**1. Vocabulary.** Match the words close in meaning from a) and b):

a) precise, to take off, chiefly, to surpass, to extract, to run on smth, to improve, to manufacture, to blame, to recognize;

b) to get better, to accuse, to pull out, to produce, to rise, accurate, to acknowledge, to work on smth, to exceed, mainly.

**2. Vocabulary.** Explain how the following words are formed. What part of speech are they? What part of speech are they made of? Translate them.

Replacement, increasingly, liquefy, chiefly, greenness, unprotected, pipeline, shipped, transportation, acknowledge.

**3. Reading.** Read the text and answer the questions below. Translate the text.

## Natural Gas

Energy firms and their investors are becoming increasingly excited about its replacement: not wind, waves or solar power but gas – or to be precise, gas that is frozen and transported as liquefied natural gas.

This is expected to become as crucial to the global economy as petroleum is today. Specialists at Royal Dutch–Shell think gas may surpass oil as the world's most important energy source by 2025. Demands for gas have taken off in recent years chiefly due to its greenness – it burns far cleaner than oil or coal, making it ideal for new power plants from California to China. Besides, burning gas is much less carbon-intensive than coal – making it harder to blame it for global warming.

Natural gas is a fuel consisting mostly of methane gas, extracted from under the ocean or ground. It contains other hydrocarbon compounds (ethane, propane, and butane) and can often be used directly without any processing. Methane is the principal component of natural gas.

A century ago, natural gas was considered a waste product in oil fields and flared or vented off. But after a giant gas field was found in the Panhandle in 1918, it was used to manufacture carbon black, which is used to make car tires. Eventually, Americans began using gas to heat their homes and, later, at power plants. But it never became as important a fuel as coal, oil or even nuclear power. A combination of circumstances has drawn new attention to natural gas.

Gas traditionally needed systems of pipelines to get it from wellhead to the customer. This meant it was typically used fairly close to where it was produced, shipped at great expense via pipeline or, more often, simply wasted. The situation needed to be changed. Put simply, gas can be frozen into liquid from near its source, shipped to market in refrigerated tankers, warmed back into gaseous state on foreign shores and injected into the local pipeline system. If the gas weren't liquefied, it would be impossible to transport it.

Due to this technological advance, gas has the potential to be global commodity like oil. The world economy runs on oil and natural gas. These fuels improve your quality of life by providing with transportation, warmth, light, and many everyday products. But for natural gas we wouldn't have clean and safe fuel for modern vehicles. Without oil and natural gas, quality of life would decline and people in developing nations would not be able to improve their standard of living. Does that mean that alternative energy sources are not necessary? Of course not. But it is important to acknowledge the value of oil and gas to the world economy and recognize that it will take decades before the alternatives can replace all of things that oil and natural gas contribute to our lives.

**Answer the questions on the text:**

1. What is natural gas? What does it contain? What is the principal component?
2. How was natural gas regarded a century ago?
3. What happened in 1918? Why did people change their opinion on natural gas?
4. How was natural gas used by Americans?
5. Why could natural gas be used only near the place of production?
6. What must be done before the natural gas can be transported?
7. Why are oil and gas an important part of our everyday life?
8. What can you say about the use of oil and natural gas in developing countries?
9. Why is natural gas use growing across all economic sectors?
10. What do oil and gas provide us with?
11. What alternative fuels do you know? Are they expected to become competitive with oil for transportation? Why?

**Are these sentences true or false?**

1. In the 19<sup>th</sup> century and early 20<sup>th</sup> century, natural gas was usually burned off in the oil fields.
2. Gas needs a system of pipelines to get to the customer.
3. Natural gas is a synthetically produced mixture of methane and other gases.
4. Natural gas will never become as important as oil or coal.
5. The world's largest proven gas reserves are located in Russia.
6. The resulting liquid is called natural gas liquid (NGL).

**4. Vocabulary.** Match the words from list A with their definitions from list B.

A.1) natural gas

2) a reservoir

3) to remove impurities

4) fossil fuels

5) biogenic methane

B. a) the result of decomposition of organic matter under great pressure without air for a long time

b) gaseous mixture of hydrocarbons

c) the result of transformation of organic matter by tiny microorganisms

d) to refine gas from water, sand and associated hydrocarbons

e) an underground trap made up of porous and permeable rocks

**5. Vocabulary.** Match suitable words from column A and B to form word combinations.

A	B
to draw	compounds
to warm back into	alternatives
to freeze	our life
to provide with	oil
to improve	gaseous state
to replace	attention
to contribute into	gas
to run on	quality of life
to contain	transportation

**6. Grammar.** Find conditional sentences in the text above. What type of conditionals are these sentences? Translate them.

**7. Vocabulary.** Choose the suitable word(s) in brackets. Both answers may be correct.

1. The total amount of oil or gas in the (a. reservoir, b. reserves) is called original oil- or gas-place (исходный нефтяной или газовый пласт).

2. Most observers agree that significant (a. deposits, b. wells) of oil and gas remain undiscovered in the Middle East.

3. Even when it is technically feasible to remove oil or gas from a specific reservoir, the (a. costs, b. prices) involved in doing so may exceed the value of the oil or gas recovered at projected (c. costs, d. prices).

4. When prices rise, underground (a. reservoirs, b. fields) can be developed economically.

5. New sources of oil and gas will replace (a. production, b. recovery) from existing wells as they decline, and help to assure adequate oil and gas supplies to meet world energy needs for the foreseeable future.

6. Reserves will also grow as more oil and gas (a. deposits, b. wells) are found around the world.

7. Oil and gas exist in the pore spaces of (a. rock, b. traps) in the subsurface of the earth.

8. Advanced technology also allows development of deep-sea (a. properties, b. fields).

**8. Vocabulary.** Put the missing words into gaps (a list of words is below the text).

Thousands of years ago, people in parts of Greece, Persia, and India noticed a gas seeping from the ground that caught ... very easily. These flames of ... sometimes became the focus of myths or religious beliefs. Natural gas is a .... of

gases, but it contains mostly ...., the smallest and lightest hydrocarbon. Like oil, natural gas is formed .... from the remains of tiny marine organisms, and it is often brought up at the same wells as .... oil. It can also come from wells, that .... only gas and condensate, or from “natural” .... that provide natural gas alone. Little use was made of natural gas until fairly .... . In the early 20th century, oil wells burned it off as a .... . Today, natural gas is highly valued as a clean .... that supplies a quarter of the world’s .....

**Words to insert:** energy, contain, natural gas, wells, fire, mixture, underground, crude, recently, waste, methane, fuel.

### **9. Skills development.** Translate the sentences into English.

1. Природный газ - одно из важнейших горючих ископаемых, занимающих важное место в экономике многих государств, и является важным сырьём для химической промышленности.
2. Основу природного газа составляет метан – простейший углеводород (органическое соединение, состоящее из атомов углерода и водорода).
3. Природный газ содержит и более тяжёлые углеводороды – этан, пропан, бутан, а также азот, углекислый газ, пары воды и другие газы.
5. Газ, добываемый из нефтяных скважин, называется попутным (associated) газом.
6. Чистый природный газ не имеет цвета и запаха.
7. Природный газ является полезным ископаемым, которое добывается, как самостоятельно, так и в качестве попутного газа.
8. Газ является самым экономичным и удобным типом топлива.
9. Газ, так же как нефть и уголь, образуется в земных недрах из органических веществ под действием высоких давлений и температур.

### **10. Skills development.**

A. Give the summary of the text in Ex. 5 about natural gas formation using the following word phrases:

#### **USEFUL LANGUAGE**

The article is entitled ... / the title of the article is ...

The article is about ...

The article considers the effects of ...

The article refers to the study/ research / survey / report / ... official figures

The article reflects the views of ... (smb) on ... (smth)

The research shows that .../ the results imply that ...  
... is important because ...  
The conclusion is that ...

B. Express your opinion on the issue.

### **USEFUL LANGUAGE**

According to the article ...; I don't think that ...; I believe it's true / it's not right; I can't agree with; that's wrong; on the one hand ...; on the other hand ....

**11. Reading.** Read the text to answer the questions below.

### **Natural Gas as a Vehicle Fuel**

Natural gas has an enormous potential for increased use as a vehicle fuel. The main barriers to this have been the short range of the vehicles, limited refueling stations, and slow refueling times. However, over the past few years refueling station prices have dropped to just a few hundred dollars, and these can be placed in residences where the vehicles can be refueled overnight or between trips.

Since about half of all residences in the United States are supplied with natural gas, the potential to increase the number of natural gas vehicles on the road is very high. In addition, the discovery of natural gas in shale deposits around the country has increased the availability of gas and decreased the price.

Natural gas has significant advantages over gasoline and diesel fuel. Natural gas vehicles emit 60-90% less smog-producing pollutants and 30-40% less greenhouse gas emissions. It also costs less per mile to operate a natural gas vehicle compared to a gasoline or diesel vehicle. Besides, natural gas is produced locally instead of imported.

Answer the questions:

1. What do you think about perspectives of natural gas vehicles in Russia?
2. What are advantages and disadvantages of natural gas as a fuel?
3. Would you like to have a car working on natural gas? Why?

### **12. Skills development.**

Make a report on the problems of natural gas use as a vehicle fuel. Look for additional information in the Internet. Compare the situations in the USA and Russia. What is the situation like in Europe? What are your own ideas on the problem?

## Unit 8

### Alternative Energy Sources

**1. Introduction.** Read the newspaper headings and decide which of the following topics they refer to. There should be a straightforward reference. Explain your choice.

A. *Climate change*: \_\_\_\_\_ B. *Alternative energy*: \_\_\_\_\_

- a) Doing nothing will result in a 25% increase in CO<sub>2</sub> emissions by 2020.
- b) The warm get warmer, the wet get wetter.
- c) Offshore wind creates onshore jobs.
- d) If the polar ice melts, sea levels could rise by more than a metre over the few decades.
- e) Several nuclear power plants in the storm's path closed.

**Discuss the questions.**

- A. What was life like before electricity was discovered? What sources of energy did people use?
- B. Imagine you have to live without electricity. What would you miss most in a world without electricity?
- C. Do you think the car of the future will be electric? Why not?
- D. Why is it important to use less fossil fuel?

#### Word combinations to remember

to take advantage (of)	electrical grid
to capture energy	to provide electricity
to propel blades of turbine	to generate electricity
to harness	to trap sun's rays
consistent	to release pollutants

**2. Vocabulary.** Translate the words without a dictionary: toxins, balance, to conserve, mechanical machinery, methane, to isolate, biomass, geothermal energy.

**3. Vocabulary.** Compare sentences in each couple. What meaning do the underlined words have? Translate the sentences taking into account the context.

1.a) Tidal power uses large turbines fixed below the surface of the waves to capture energy from strong tidal currents.

b) As Faraday showed us, electric currents produce magnetic fields.

2.a) Consistent wind is needed for continuous power generation.

b) Most people of my father's generation have experienced war.

3. a) Tidal power also uses large turbines fixed to the sea bed.

b) The hotel room was large with a comfortable bed.

4.a) By the end of the twentieth century, tidal power plants were in operation in France, Russia, Canada, and China.

b) Hundreds of books were published on the behaviour of the animals and distribution of plants over the earth.

5.a) Geothermal heat pumps, one of three geothermal technologies popular in the US, are used for space heating and cooling as well as water heating, for residential and commercial applications.

b) Natural gas can come from well which contains only gas and condensate.

**4. Vocabulary.** One word is odd. Find one word that doesn't correspond to the definition.

1. resources that can be depleted: coal – oil – natural gas – wind;

2. inexhaustible natural resources: sun – wind – fossil fuels– geothermal;

3. exhaustible natural resources: iron ore – copper – sun energy – fossil fuel;

4. kinds of energy: geothermal – scarce – exhaustible – solar.

**5. Reading.** Read the text about alternative energy sources quickly and find the answers to the questions.

1. What energy source (sources) is (are) the largest CO<sub>2</sub> emissions-free source of energy? Why is it popular?

2. What energy source (sources) causes the most negative social consequences? Why?

3. What energy sources need no fuel?

4. What energy sources are the least popular? Why?

5. What energy sources depend on the weather conditions? How?

6. What energy source helps solve another ecological problem apart from the need to replace fossil fuels?

### **Different Types of Alternative Energy Sources**

There are many reasons the world is looking for alternative energy sources in an effort to reduce pollutants and greenhouse gases. Alternative energy sources show significant promise in helping to reduce the amount of toxins that are by-products of energy use and help preserve many of the natural resources that we currently use as

sources of energy. To understand how alternative energy use can help preserve the delicate ecological balance of the planet, and help us conserve the non-renewable energy sources like fossil fuels, it is important to know what types of alternative energy can be found at present. Let us take a look at some of the most common sources available.

### **a) Hydroelectric Power**

By taking advantage of gravity and the water cycle, we have tapped into one of nature's engines to create a useful form of energy. In fact, humans have been capturing the energy of moving water for thousands of years. Today, harnessing the power of moving water to generate electricity, known as hydroelectric power, is the largest source of emissions-free, inexhaustible electricity worldwide.

Although the generation of hydropower does not emit air pollution or greenhouse gas emissions, it can have negative environmental and social consequences. Blocking rivers with dams can degrade water quality, damage aquatic habitat, block migratory fish passage, and displace local communities. The benefits and drawbacks of any proposed hydropower development must be weighed before moving forward with any project.

In order to generate electricity from the kinetic energy in moving water, the water has to move with sufficient speed and volume to spin a propeller-like device called a turbine, which in turn rotates a generator to generate electricity. Roughly speaking, one gallon of water per second falling one hundred feet can generate one kilowatt of electricity.

### **b) Wind Power**

Wind energy harnesses the power of the wind to propel the blades of wind turbines. The rotation of turbine blades is converted into electrical current by means of an electrical generator. In the older windmills, wind energy was used to turn mechanical machinery to do physical work like crushing grain or pumping water. Wind towers are usually built together on wind farms. Now, electrical currents are harnessed by large-scale wind farms that are used by national electrical grids as well as small individual turbines used for providing electricity to isolated locations or individual homes. In 2005, worldwide capacity of wind-powered generators was 58,982 megawatts, their production making up less than 1 percent of worldwide electricity use.

Wind power produces no pollution that can contaminate the environment since no chemical processes take place and no harmful by-products left over as in the burning of fossil fuel; since wind generation is an inexhaustible source of energy, we will never run out of it; farming and grazing can still take place on land occupied by wind turbines which can help in the production of biofuels.

However, consistent wind is needed for continuous power generation. If wind speed decreases, the turbine will stop.

### **c) Solar Power**

Solar energy is used commonly for heating, cooking, the production of electricity, and even in the desalination of seawater. Solar power works by trapping the sun's rays into solar cells where this sunlight is then converted into electricity. Additionally, solar power uses sunlight that hits solar thermal panels to convert sunlight to heat water or air. Other methods include using sunlight that hits parabolic mirrors to heat water (producing steam), or simply opening room blinds or window shades to allow entering sunlight to passively heat a room.

Solar power generation releases no water or air pollutants because there is no chemical reaction from the combustion of fuels; solar energy can be applied very efficiently for practical uses such as heating and lighting; the benefits of solar power are seen frequently to heat pools, spas, and water tanks all over.

But solar power does not produce energy if the sun is not shining; nighttime and cloudy days seriously limit the amount of energy produced; moreover, solar power stations can be very expensive to build.

### **d) Geothermal Energy**

Geothermal literally means "earth heat." Geothermal energy harnesses the heat energy which is present underneath the Earth. Hot rocks under the ground heat water to produce steam. When holes are drilled in the region, the steam that shoots up is purified and is used to drive turbines, which power electric generators.

If done correctly, geothermal energy produces no harmful by-products; geothermal power plants are usually small and have little effect on the natural landscape. If done incorrectly, geothermal energy can produce pollutants, improper drilling into the earth can release hazardous minerals and gases; geothermal sites are prone to running out of steam.

### **e) Tidal Energy**

Another variation is to make use of water's kinetic energy such as wave and tidal power. Although still in its development stage, there are two ocean-based technologies with high potential for providing a clean, free alternative energy source in the future. Wave power uses the kinetic energy of the ebbing, flowing of the oceans waves and tides by trapping water in tidal barrages or through underwater tunnels, which is then used to rotate tidal turbines. Tidal power also uses large turbines fixed to the sea bed or just below the surface of the waves to capture the energy from strong tidal currents.

The rise and fall of ocean tides contain enormous amounts of energy that can be captured to produce electricity. In order for tidal power to be effective, however, the difference in height between low and high tides needs to be at least 20 feet (6

meters), and there are only a few places in the world where this occurs. A tidal station works like a hydropower dam, with its turbines spinning as the tide flows through them in the mouths of bays or estuaries (an arm of the sea at the lower end of a river), generating electricity. By the end of the twentieth century, tidal power plants were in operation in France, Russia, Canada, and China. Ocean thermal energy uses the temperature change between the warmer surface waters and the colder depths to produce electrical power.

#### **f) Biomass Energy**

Certain biomass (the sum of living and dead plants, animals, and microorganisms in an area) can be used as fuel to produce heat energy. Wood, crops and crop waste, and wastes of plant, mineral, and animal matter are part of the biomass. The biomass contained in garbage can be burned to produce heat energy or can be allowed to decay and produce methane (natural gas). In Western Europe, over 200 power plants burn rubbish to produce electricity. Methane can be converted to the liquid fuel methanol, and ethanol can be produced from fermentable crops such as sugar cane and sorghum. Adequate air pollution control is necessary when biomass is burned to limit the release of carbon dioxide into the atmosphere.

#### **Comprehension check questions**

1. Why do we have to develop alternative sources of energy?
2. What is the solar energy used for?
3. What are disadvantages of wind power?
4. What requirements should hydroelectric power stations meet?

#### **6. Vocabulary.** Match two verbs from a) and b) that are synonyms:

**a)** to conserve, to use, to generate, to rotate, to trap, to take place, to damage, to emit;

**b)** to capture, to preserve, to produce, to harm, to occur, to spin, to release, to apply.

**7. Vocabulary.** Match adjectives that are synonyms: continuous, current, hazardous, non-renewable, contaminated, at present, consistent, exhaustible, dangerous, polluted.

#### **8. Vocabulary.** Match words in a) with their opposites in b):

**a)** abundant, high tide, to increase, harm, strong, dead, to preserve, dangerous, to pollute, drawback, to help, intermittent;

**b)** living, to destroy, safe, to purify, weak, advantage, to decrease, to prevent, scarce, consistent, benefit, ebb.

#### **9. Word formation.** Make the following words negative:

efficient, renewable, sufficient, natural, dangerous, correct, useful, significant, available, living.

**10. Vocabulary.** Translate noun combinations into Russian:

greenhouse gas emissions, potential alternative energy source, air pollution control, surface waters, waves height difference, solar power station, solar power generation, moving water energy, alternative energy use, sun power generator prototype, electric car charging station, solar power plant construction project.

**11. Vocabulary.** Match verbs and nouns to make word combinations.

verb	noun
To take	pollutants
To harness	advantages
To run out of	sun rays
To release	turbines
To drive	electricity
To trap	consequences
To have	power of water

**12. Vocabulary.** Put the missing words from the list given bellow the text into gaps.

**a) How Does a Hydroelectric Power Plant Work?**

For power to be generated, three things must be present: flowing water, a .... , and a generator. Flowing water from the .... or upstream river strikes the turbine and causes it .... . The turbine is connected to the generator, so, when the turbine is spinning, it causes the .... to start running, eventually, producing .... .

The principle of .... power is similar to that of .... energy which rotates the wheels of the turbine by its energy. Hydroelectric power uses the natural flow of water to give mechanical energy to turbines .... electricity. The water flows .... to provide energy. Gravitational energy gives water kinetic .... required for the flow.

**Words to insert:** energy, power, turbine, dam, to produce, continuously, to rotate, generator, hydroelectric, wind.

**b) How does solar system work?**

The purpose of any .... system is to collect solar .... and convert it into useful thermal .... . It consists of a number of absorbers or .... . These are made of plates of fiber with .... tubes inside. The tubes are connected to a metal ..... . This surface

is black in order to .... more energy. The system works as follows: the sun .... pass through the glass and heat water flowing through the copper .... . When the water is heated it .... steam and the steam is used to move a ..... which turns a generator. This device then transforms heat into .....

**Words to insert:** electricity, tubes, solar, produces, radiation, energy, collectors, copper, surface, absorb, rays, turbine.

### c) Tidal Energy

Tidal energy comes from the .... of ocean tides. One way to use the power of .... is to seal off a bay with a dam. When water moves into and out of the .... it turns a turbine, which produces ..... . There are some coastal areas around the world where the ..... between high and low tide is up to 10 metres and more. Great Britain, the Netherlands, Germany or France have coastal regions where such power can be .....

**Words to insert:** electricity, movement, created, waves, bay, electricity,

### d) Geothermal Energy

Geothermal .... can be produced in places where water comes into contact with hot rock below the earth's ..... . The water that reaches these hot areas turns into ..... , which then produces electricity. In places where no natural ..... water supplies exist, engineers pump it into the hot rock layers.

Geothermal heat is an important .... of energy in countries that lie in volcanic areas, such as Iceland, Italy, New Zealand, California or the Philippines. Geysers are .... of hot water that come to the surface. Such naturally .... water is used to heat homes and greenhouses.

**Words to insert:** eruptions, source, surface, steam, heated, underground, power.

### e) Biomass

Biomass is material that .... plants and animals. It .... energy that the sun has produced and when burned produces heat. Wood, plants and crops are the most important sources of .... today.

Biomass can also be .... other forms of energy , like gas, ethanol or .... . In Brazil, for example, about 20 % of all cars are driven by .... produced from sugar cane. Biomass is also a .... source of energy because crops and trees can always grow.

**Words to insert:** renewable, ethanol, comes from, changed into, contains, biodiesel, biomass.

### 13. Grammar revision.

a) Find ing-forms in the text in Ex.5 above. What parts of speech are they. Translate them into Russian.

b) Find ed-forms in the text in Ex.5 above. Translate them into Russian and explain your translation.

### 14. Grammar revision.

Find conditional sentences in parts **b-d** of the text in Ex.5 above. Which types do they belong to? Transform these sentences into other types and translate them into Russian.

### 15. Skills development. Translate the text into English.

#### Энергия из мусора

Специалисты из Тайланда разработали экологически чистый и даже прибыльный способ утилизации бытовых отходов. Там введена в эксплуатацию первая электростанция, работающая на газе, который выделяется при гниении отходов на мусорных свалках. Этот проект поможет густонаселенному острову решить одним махом две проблемы: ликвидировать дефицит электроэнергии и избавиться от избытка мусора. Эта уникальная электростанция сможет работать на отведенном ей мусорном котловане около 10 лет, снабжая электроэнергией 7000 домов.

**16. Skills development.** Make a report on the alternative energy you are especially interested in. Tell about advantages and disadvantages of this type of energy. Give examples of its use in your locality. Is it possible to use alternative energy in everyday life?

### 17. GRAMMAR: RELATIVE PRONOUNS: instruction and practice.

**I.** There are only a few relative pronouns in the English language. The most common are **which, that, whose, whoever, who, and whom**. It is necessary to note that relative pronouns **who, whom** are used for people; **that, whose** – for people, animals and things; **which** – for animals and things. Sometimes relative pronouns can be accompanied by propositions.

Translate the sentences into Russian:

1. It is an environmental friendly way of energy production **in which** biological mass is recycled and re-used.
2. However, in the present time there are several windmills **that** are used to generate required energy mostly for industrial uses.
3. This is the energy **which** the earth receives from the Sun. This is one of the most promising alternative energy sources, **which** will be available to the mankind for centuries to come.
4. It is an environmental friendly way of energy production **in which** biological mass is recycled and re-used.
5. Alternative sources of energy are the ones **which** do not cause any undesirable consequences to the environment, are renewable and are free!
6. Such a system, **which** produces cheap energy from our oceans, will probably take years or decades to develop.
7. Biomass is material **that** comes from plants and animals and contains energy **that** the sun has produced and, when burned, produces heat.
8. It was a Swedish scientist named Svante Arrhenius **who** was the first to state that the use of fossil fuel could contribute to global warming, way back in 1896.
9. A small company from Thailand “Vitamilk”, **whose** main field of expertise is soy milk production, found a solution to the problem of dead batteries. During their advertising campaign, the company has created a device **that** allows to use the remaining bits of energy from the used batteries.
10. In July, Tom Konrad gave an estimated range **within which** he expected ten stocks of natural gas to finish in 2015.
11. The main reason why many people today turn to alternative energy sources for their homes is **that** it gives them independence and freedom.

**II.** In some situations, the words **why**, **when**, and **where** can function as relative pronouns. They are usually used instead of **at which**, **on which**, **in which**, **for which**:

1. Solar power generators can be used to generate power in rural and remote areas **where (in which)** there is no reach of the conventional form of energy.
2. Wind power is an effective alternative source of energy in areas **where (in which)** the velocity of wind flow is high.
3. The downside area is the place **where (in which)** alternative energy sources are not always available due to its specific locality.
4. A danger is the situation **when (at which)** something goes wrong with a nuclear power plant.
5. Do you know the reason **why (for which)** the research has been closed.

6. There isn't a day **when (on which)** I don't think about terrible consequences of the disaster.

7. You can also find such panels on buildings in larger cities, or even on houses all around the globe, **where (in which)** people use solar energy for their household activities.

**III. Which** is always used to introduce relative clauses when they refer to the whole sentence:

1) For example, there might be times when the winds will not blow in its full force, **which** would mean that it will not move the turbines on the wind farms with proper force.

2) The team produced the gas continuously over four days until the wastewater ran out, **which** is significant, because comparable systems that produce chemicals from water have historically failed after a couple hours of use.

**IV.** Relative pronoun can be left out when it is the object of the verb. If it is the subject of the verb, we never leave it out. Compare two sentences:

1. Biomass as material comes from plants and animals and contains energy (**that**) the sun has produced.

2. The term alternative energy also is used for energy derived from sources and technologies **that** do not involve the depletion of natural resources or significant harm to the environment.

**Let's summarise!**

**Defining relative clauses. They are essential for understanding.**

*Biomass is material **that** comes from plants and animals and contains energy **that** the sun has produced and, when burned, produces heat.*

*In July, Tom Konrad gave an estimated range **within which** he expected ten stocks of natural gas to finish in 2015.*

the thing	that (which)
the person	who (that)
the place	where

**Non-defining relative clauses. They are not essential for understanding and provide additional information.**

*A small company from Thailand “Vitamilk”, whose main field of expertise is soy milk production, found a solution to the problem of dead batteries.*

the thing	which
the person	who
the place	where

And do not forget the comma for **Non-defining relative clauses!**

**18. GRAMMAR: RELATIVE PRONOUNS. Practice.** Put suitable relative pronouns (who, which, that) into gaps.

### **What are the Different Types of Solar Energy Equipment?**

The different types of solar energy equipment include a large variety of devices .... permit energy from the sun to be trapped and converted to usable energy, such as electricity or thermal energy. Solar energy equipment is often categorized into two main types: thermal equipment ..... produces heat, and photovoltaic equipment, or photovoltaic cells, .... produce electricity. Solar energy is a massive source of renewable energy .... humans have only tapped on a relatively small scale.

There are many people .... are interested in thermal equipment. Solar energy production with thermal equipment can be used for many applications, such as for heating buildings, or producing hot water for residential use or for use in industrial processes. Thermal systems can also be used to generate electricity indirectly by means of a type of solar energy equipment ..... is known as a heat engine. Another way of creating electricity using thermal solar power is to use the solar power energy to produce steam, .... is able to power turbines ..... generate electricity.

**19. Skills development.** Look through the text to catch the main information. Make brief presentations of the innovative ideas (products).

### **ALTERNATIVE ENERGY IN USE**



**A.** Designed by famous Italian architect Zema and produced by EcoFloLife, the WaterNest-100 is an eco-friendly floating housing unit. The 100 square meter residential units are made of up to 98% recycled materials, including the laminate timber and aluminum hull. Skylights, balconies and large windows encircle the dwelling, allowing for efficient lighting and beautiful waterfront views. 60 m<sup>2</sup> of photovoltaic panels embedded in the rooftop provide up to 4 kW of internal electricity. A sophisticated system of natural micro-ventilation and air conditioning classifies it as a low-consumption residential habitat.

The units can be positioned along rivers, lakes, bays, atolls and calm sea areas. The interiors are warm and welcoming, and include a living room, dining room, bedroom, kitchen and bathroom. The 12 m diameter circular layout can be configured as a house (1 to 4 people), office, lounge bar, restaurant, shop, or exhibition space. The EcoFloLife catalogue provides top-design eco-friendly furnishings that complement the design and meet most contemporary needs.

**B.** In an effort to reduce China's harmful and plentiful greenhouse gas emissions, Chinese company Sifang (a subsidiary of China South Rail Corporation) has developed the world's first hydrogen powered tram. The tram took two years of research and development to complete, and will be powered entirely by hydrogen fuel cells. Since this is a tram and not a train, the top speed will only be 70 kilometers per hour and it will be used in urban areas only. It is designed to carry 380 passengers.

The tram will take 3 minutes to refuel and will have a 100 kilometer range. The company says the main benefits for cities will be cleaner air and reduced operation costs. The only emission will be water. It will not produce nitrogen oxides, as the temperature of the fuel cells will be kept under 100 degrees Celcius.

**C.** The spherical sun power generator. German Architect Andre Broessel believes he has a solution that can "squeeze more juice out of the sun", even during the night hours and in low-light regions. His company Rawlemon has created a spherical sun power generator prototype called the beta-ray. His technology will allow twice the yield of a conventional solar panel in a much smaller surface area. The futuristic design is fully rotational and is suitable for inclined surfaces, walls of buildings, and anywhere with access to the sky. It can even be used as an electric car charging station.

**D.** Russia has set its sights on developing alternative sources of energy in remote areas, despite climate conditions and rich natural reserves. Recently the Republic of Altai launched the country's largest solar power plant. Until recently, Russia had been developing solar energy primarily in the space industry. The times are changing, yet the value of hydrocarbons remains important. Russia seeks to develop solar power in hard-to-access regions with a high level of solar radiation.

In September, work at Russia's largest solar power plant was initiated in the village of Kosh-Agach in Altai. This is Russia's first 5-megawatt (MW) solar power facility. Prior to that, the most powerful facilities were no more than 2 MW. This station is the first of five solar power plant construction projects in the Republic of Altai, which combined will have a 45-MW capacity.

**20. Skills development. Speaking.**

1. Make a list of fossil fuels and explain how they may harm the environment.
2. List three alternative sources of energy and explain how they work.
3. Give examples of products and services which can be run on alternative sources of energy.

**21. Vocabulary.** Match the words on the left with their definitions on the right:

**A. Nouns:**

- |                |  |
|----------------|--|
| 1. electricity | a. state of being hot  |
| 2. flood       | b. machine for converting mechanical energy into electrical energy |
| 3. generator   | c. vapour into which water changes when boiled                     |
| 4. wave        | d. form of energy with moving electrons                            |
| 5. heat        | e. overflow of water on the normally dry area                      |
| 6. steam       | f. moving ridge on water   |

**B. Adjectives:**

- |                |                                |
|----------------|--------------------------------|
| 1. alternative | a. of the sun                  |
| 2. enormous    | b. making a lot of loud sounds |
| 3. solar       | c. very big, vast              |
| 4. noisy       | d. high-priced                 |
| 5. expensive   | e. one of two choices          |

**C. Verbs:**

- |               |   |
|---------------|---|
| 1. to use     | a. to keep things for future use                          |
| 2. to replace | b. to soak up a liquid; take in                           |
| 3. to collect | c. to move an object towards the source of the force      |
| 4. to absorb  | d. to make hot  |
| 5. to store   | e. to gather or to be gathered together; accumulate       |
| 6. to push    | f. to manufacture   |
| 7. to pull    | g. to move or try to move by steady force                 |
| 8. to produce | h. to put into service or action; take advantage of; cons |
| 9. to heat    | i. to consume or expend;                                  |
|               | j. to substitute for; put back                            |

**22. Vocabulary.** Replace the words and phrases in italics with words of similar meanings given below:

1. Companies are being encouraged *alternative* ..... energies.
2. A steep rise in price of oil could be *devastating* ..... for large numbers of busenesses.
3. Energy companies claim there is currently *lack* ..... of oil.
4. The increase in energy *use* ..... is resulting in high levels of pollution throughout the world.
5. The price of *getting oil out of the ground* ..... is rising rapidly.
6. Many countries are *reliant* ..... on fossil fuels.
7. We need to find new *origins* ..... of energy.
8. What will be the *effects* ..... of limited oil supplies?
9. *Discharges* ..... of pollution have never been so high.
10. Reserves will be *used up* ..... within the next 20 years, experts predict.

**Words to insert:** inexhaustible, catastrophic, shortage, consumption, extracting, dependent, sources, consequences, depleted, emissions.

**23. Skills development. Speaking.** Surf the Internet for information on solar energy equipment. Make a presentation of the most popular systems.

**24. Skills development. Speaking.** Imagine you are a representative of a company producing some alternative energy equipment. Prepare a presentation of your equipment for an exhibition.

## Unit 9

### Waste Management

**1. Introduction. Read the definitions. Try to notice the difference in meaning between the words.** Прочитайте выдержки из толкового словаря. Все слова, приведенные ниже, имеют одинаковый перевод на русский язык («мусор, отходы»). Попытайтесь найти различия между значениями этих слов, в каких случаях употребляется каждое из них?

**Then read the article below and check your guess.**

garbage: (1) especially AmE waste material, such as paper, empty containers, and food thrown away; = rubbish BrE [...]

litter: (1) WASTE [U] waste paper, cans etc that people have thrown away and left on the ground in a public place; = rubbish, trash, garbage: People who drop litter can be fined in some cities. | a town with a litter problem. [...]

**rubbish:** [U] especially BrE (1) food, paper etc that is no longer needed and has been thrown away; = garbage AmE, trash AmE [...]

**trash:** (1) AmE, things that you throw away, such as empty bottles, used papers, food that has gone bad etc; = rubbish BrE [...]

**waste:** (4) UNWANTED MATERIALS [U] unwanted materials or substances that are left after you have used something: The emphasis is on recycling household waste. | industrial/chemical etc waste proposals to end the dumping of industrial waste into rivers and seas | waste pipes | the disposal of hazardous waste -> nuclear waste, toxic waste -> see picture at ENVIRONMENT [...]

**junk:** informal old or discarded articles that are considered useless or of little value, ‘the cellars are full of junk’

**refuse:** matter thrown away or rejected as worthless; rubbish.

### Words that are often confused: rubbish, trash, garbage

In this post I’m going to talk rubbish. Does that mean I’ll be talking nonsense? No, actually I’m going to look at vocabulary connected to rubbish in the sense of household waste, including synonyms and related words.

So, rubbish is the stuff that we throw out of our homes. You may also have heard other words for the same thing: garbage, refuse, trash, litter, as well as words like dustbin and trash can.

Why are there different words for *rubbish*, and what’s the difference? In some cases, which word we use depends on whether we’re British or American. Let’s try to make some sense of all this rubbish!

#### Words for *household waste*

<b>rubbish</b> [uncountable noun]	This is British English (BrE). British people throw away <i>rubbish</i> .
<b>garbage, trash</b> [uncountable nouns]	American English (AmE) – Americans throw away <i>garbage</i> and <i>trash</i> .
<b>garbage vs. trash</b>	Americans differentiate between type here: <i>garbage</i> is used for waste from the kitchen – ‘wet’ waste, you could say; <i>trash</i> is things like paper and packaging – ‘dry’ materials.
<b>litter</b> [uncountable noun]	This is not household waste. <i>Litter</i> is small things such as cans, bottles and paper that people leave lying on the streets and in other public places.
<b>refuse</b>	This is a more formal word for <i>rubbish</i> , <i>garbage</i> and <i>trash</i> .

[uncountable noun]	The pronunciation is /'refju:s/
<b>dustbin,</b> <b>rubbish bin</b> [countable nouns]	(BrE) A <i>dustbin</i> is a small container for <i>rubbish</i> , mostly outside. The modern type, with wheels, is called a <i>wheelie bin</i> .
<b>garbage can,</b> <b>trash can</b> [countable nouns]	(AmE) A small container for <i>garbage</i> and <i>trash</i> , usually outside.
<b>litter bin</b> [countable noun]	A small container in a street or other public place where people can put <i>litter</i> .

**And to collect all this waste we need the following:**

<b>refuse collector, waste collector</b>	These are formal words for the person who takes away <i>refuse/rubbish/garbage</i> .
<b>dustman, bin man</b>	These are informal words used in BrE for a <i>refuse collector</i> .
<b>trash collector, garbage collector, garbage man</b>	These are informal words used in AmE for a <i>refuse collector</i> .
<b>dustbin lorry, dustcart (BrE), garbage truck, trash truck (AmE)</b>	This is the vehicle used to take away <i>refuse/rubbish/garbage</i> .

**2. Vocabulary.** Fill in the gaps. Use the words from the task above. Explain your choice.

- a) For the first time, researchers show that marine ... can even be found at the sea surface of Arctic waters.
- b) Scientists discovered 'supramolecule' that could help reduce nuclear and agricultural ... .
- c) Now researchers are advancing another potential approach using sugar alcohols — an abundant ... product of the food industry — mixed with carbon nanotubes.
- d) ... collectors are important for removing ...; without them ... accumulates and can quickly become a health hazard.

- e) Landfills can make a profit from all their rotting ... and a new patent explains exactly how to make the most out of the stinky ... sites.
- f) A 150-foot-high ... dump in Colombia, South America, may have new life as a public park.
- g) Imagine if you could turn old ... into new houses.
- h) More than half the world's sea turtles have ingested plastic or other human ..., an international study has revealed.
- i) The ash is what is left when ... has been burnt in thermal power stations.
- j) ... incineration is a widespread practice in Europe.
- k) Ash from refuse could become hydrogen gas.
- l) The bulla was discovered in a ... dump dated to the time of King Hezekiah or shortly after, and originated in the Royal Building that stood next to it and appears to have been used to store foodstuffs.
- m) But from the standpoint of obesity prevention, it is only helpful if people replace ... food with healthy food.
- n) A combination of pop songs, talkback radio and cutting-edge science has enabled Australian astronomers to identify a way to prevent catastrophic, multi-billion dollar space ... collisions, a new study has revealed.

**3. Vocabulary.** Translate the words.

Resident, hazardous, debris, mining, fossil fuel, combustion, consumption, incineration, refinery.

**4. Grammar.** Translate into Russian, pay attention to the underlined participles.

1. Many different types of waste are generated, including municipal solid waste, agricultural and animal waste (...)
2. The amount of waste produced is influenced by economic activity, consumption, and population growth.
3. Developed societies, such as the United States, generally produce large amounts of municipal solid waste.
4. Waste often was deposited on land just outside developed areas.
5. Modern landfill facilities are engineered with containment systems and monitoring programs.

**5. Reading.** Answer the questions.

1. Read the headline. Try to guess what the text is about.
2. Do you know the main sources of waste?
3. Write down the words associated with wastes before reading the text and complete your list after reading.

## Waste Generation

Virtually every resident, organization, and human activity in the United States generates some type of waste. Many different types of waste are generated, including municipal solid waste, agricultural and animal waste, medical waste, radioactive waste, hazardous waste, industrial non-hazardous waste, construction and demolition debris, extraction and mining waste, oil and gas production waste, fossil fuel combustion waste, and sewage sludge. The amount of waste produced is influenced by economic activity, consumption, and population growth. Developed societies, such as the United States, generally produce large amounts of municipal solid waste (e.g., food wastes, packaged goods, disposable goods, used electronics) and commercial and industrial wastes (e.g., demolition debris, incineration residues, refinery sludges). Among industrialized nations, the United States generates the largest amounts of municipal solid waste per person on a daily basis.

Waste generation, in most cases, represents inefficient use of materials. Tracking trends in the quantity, composition, and effects of these materials provides insight into the efficiency with which the nation uses (and reuses) materials and resources and provides a means to better understand the effects of wastes on human health and ecological condition.

### 6. Vocabulary. Match the term with its translation:

1) municipal solid waste	a) радиоактивные отходы
2) agricultural and animal waste	b) отходы сжигания ископаемого топлива
3) medical waste	c) твердые бытовые отходы
4) radioactive waste	d) промышленные неопасные отходы
5) hazardous waste	e) сельскохозяйственные отходы и отходы
6) industrial non-hazardous waste	животноводства
construction and demolition debris	f) осадка сточных вод
7) extraction and mining waste	g) строительный и монтажный мусор
8) oil and gas production waste	h) отходы нефтегазодобычи
9) fossil fuel combustion waste	l) медицинские отходы
10) sewage sludge	j) опасные отходы
	k) отходы горно- добывающего и перерабатывающего производства

### 7. Word formation. Complete the table.

noun	verb
	generate

production	
	influence
amount	
	use
composition	

**8. Word formation.** Give all possible participle forms of the following verbs.

Make four sentences with the participles.

Generate, include, produce, influence, develop, represent, use, provide, contribute.

**9. Vocabulary.** Translate the terms:

Reuse (n.), recycling, storage, disposal, land disposal unit, treatment, landfill, surface impoundment, underground injection, containment system, degraded air quality, open-burning dump, disease vector hazard.

**10. Skills development.** Read and translate the text.

### **Waste Management**

Once generated, wastes must be managed through reuse, recycling, storage, treatment, and/or disposal. Most municipal solid wastes and hazardous wastes are managed in land disposal units. For hazardous wastes, land disposal includes landfills, surface impoundments, land treatment, land farming, and underground injection. Modern landfill facilities are engineered with containment systems and monitoring programs.

Current approaches to waste management evolved primarily due to health concerns and the need to control odors. In the past, waste often was deposited on land just outside developed areas. More recently, excavation of land specifically for deposition of wastes became common, often accompanied by burning of wastes to reduce volume, a practice eventually determined to be a contributor to degraded air quality in urban areas. Burning of wastes occurred at multiple levels, from backyard burning to large, open-burning dumps of municipal solid wastes to onsite burning of commercial and industrial wastes. Land disposal created problems such as ground water contamination, methane gas formation and migration, and disease vector hazards.

**11. Skills development.** Speaking. Answer the questions. Then translate the text.

1. What approaches to waste management do you know?
2. How are wastes managed in your country (region, city, town)?
3. What did people do with wastes in the past? Was it harmful for the environment?

**12. Grammar.** Make participle 1 or participle 2 of the verbs in brackets.

### Effects

The effects associated with waste vary widely and are (influence) by the substances or chemicals (find) in waste and how they are (manage). Although data do not exist to directly link trends in waste with effects on human health and the environment, the management of waste may result in waste and chemicals in waste (enter) the environment.

Hazardous waste, by definition, has the potential to negatively affect human health and the environment, which is why it is so strictly (regulate). Hazardous wastes are either specifically (list) as hazardous by EPA or a state, or exhibit one or more of the (follow) characteristics: ignitability, corrosivity, reactivity, or toxicity.

Municipal solid waste landfills are the third-largest source of human-related methane emissions in the United States, (account) for approximately 18 percent of these emissions in 2012. Methane is one of several non-CO<sub>2</sub> gases that contribute to global climate change. Methane gas is (release) as wastes decompose, and emissions are a function of the total amount and makeup of the wastes as well as management facility location, design, and practices.

**13. Vocabulary.** Classify different types of wastes, complete the table.

solid	liquid	semi-liquid	containerized gaseous material
-------	--------	-------------	-----------------------------------

waste tires, septage, scrap metal, latex paints, furniture, toys, garbage, appliances, vehicles, oil, anti-freeze, empty aerosol cans, paint cans, compressed gas cylinders, construction and demolition debris, asbestos.

**14. Reading.** What do you know about wastes? What problems are associated with wastes? Complete two columns of the table before reading and the third column after reading the text.

already know	want to know more	I've learnt this from the text

### What is Waste Disposal?

Be it used plastic bags, broken glass, an obsolete cell phone, or used battery cells, they are all used products that require appropriate disposal to limit their harm to the

environment. Waste disposal is therefore a systematic action for managing waste from its origin to its final disposal. It includes incineration/burning, burial at landfill sites or discharge at sea/lake/river, and recycling. Let us now look at various waste disposal problems more closely.

### ***1. Production of too much waste***

One of the major waste disposal problems is attributed to the generation of too much waste. America alone is responsible for the producing of about 220 million tons of waste annually. It's recorded that Americans generated nearly 260 million tons of municipal solid waste. This is about 2.1 kg per person each day. The point is; if these are only figures in America, let's try to imagine the amount of waste produced by the rest of the population across the globe.

### ***2. Most of the waste is toxic***

The majority of the state and local authority legislations are generally lax on regulating the ever-expanding manufacturing industries. On a daily basis, these industries produce toxic products that end up getting thrown away after use. Most of the products contain hazardous and health-threatening chemicals.

### ***3. Landfills are a problem as well***

Most landfills lack proper on-site waste management thereby contributing to additional threats to the environment. In the long-term, landfills leak and pollute ground water and other neighboring environmental habitats making waste management very difficult. They also give off potentially unsafe gases.

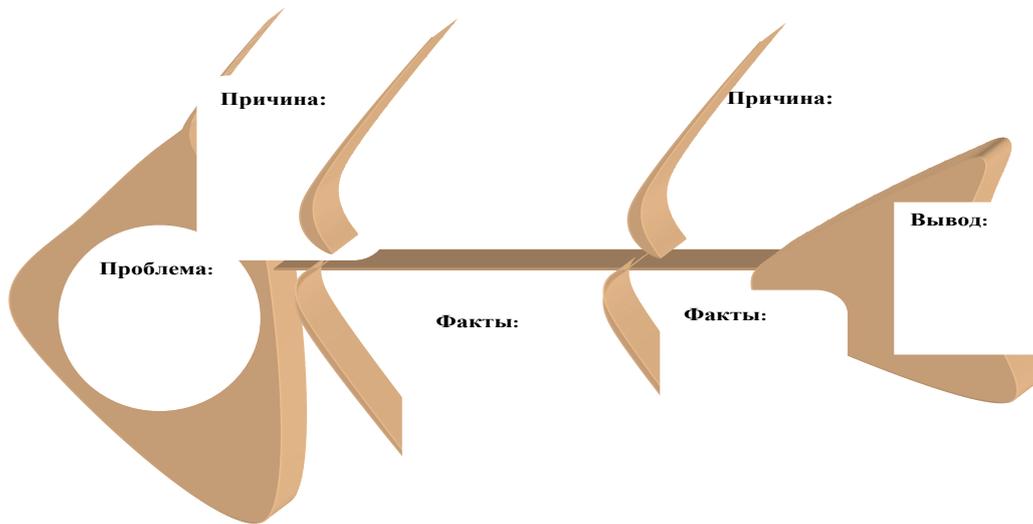
### ***4. Reliance of dying technologies to reduce and recycle waste***

Waste disposal and management facilities as well as state resources have continued to rely on myopic and quickie solutions instead of developing effective recycling and waste reduction programs. Consequently, it has created continued reliance on the use of outdated technologies to deal with waste disposal. The problem is that most states are reluctant and less creative towards advancing novel technologies for reducing the toxicity and volume of waste or enhancing recycling, especially solid waste.

## **15. Learning skills development.**

Underline the main ideas of the text and write them down using the following graphic form "fish bone":

Тема занятия:



**16. Grammar.** Find participle 1 and participle 2 in the text and pay attention to their translation.

**17. Word formation.** Match the term with its translation:

1) waste disposal	а) эффективная переработка
2) effective recycling	б) уменьшать, сокращать
3) incineration/burning	в) утечка
4) reduce	г) угрожать окружающей среде
5) landfill	д) химические вещества, опасные для здоровья
6) health-threatening chemicals	е) объем отходов
7) volume of waste	ж) утилизация отходов
8) threat to the environment	з) мусорная свалка
9) leak	к) сжигание

**17. Grammar.** Translate the sentences, pay attention to the Absolute Participial Construction.

1. The O<sub>2</sub> that reacted with substances in gasoline is conserved too, with most being converted to CO<sub>2</sub>.
2. In general, productivity is highest where there is a strong circulation of water, with upwelling currents bringing deep water to the surface.
3. Glaciers disappearing from the Himalayas, hundreds of millions of people could have their water supplies threatened.

4. At the top end of the food chain there are significant linkages with the surface food chain, with higher carnivores preying on animals from both the autotrophic and the detrital systems.
5. Thus ideal soil conditions for the most efficient decomposition of organic detritus are generally in the range pH 5.5–8.0, with the optimum being about neutral (7.0).
6. Water becoming more acidic, it is less able to absorb CO<sub>2</sub>.
7. In all, such forests may have up to seven discernible strata or stories of above-ground plants, with the lower layers being composed of species adapted to low levels of light availability.
8. Among most classes of common organic compounds, biochar has been shown to adsorb PAHs particularly strongly, with desorption having been regarded as ‘very slow’.
9. Technology developing to collect and sort plastics more efficiently and economically, each can be recycled to specific higher-value uses.
10. Similarly, the measured mean number diameter of biomass-burning smoke less than 4 minutes old is 0.10 to 0.13 μm, yet the mass of such aerosol particles increases by 20 to 40 percent during aging, with one third to one-half the growth occurring within hours after emissions.

**18. Grammar.** Open the brackets using appropriate form of the verbs.

- 1) If more people around the world (recycle), it could help minimize the negative impact of pollution, including debris littered across land and water.
- 2) If people had known how to recycle waste, there (be) so many problems.
- 3) If I study ecology, I (help) to clean our planet.
- 4) If everyone in the world recycled, there (not be) as large a collection of plastic floating in the ocean.
- 5) If there (be) recycling plastic, it would reduce our collective carbon footprint on the planet.
- 6) If all disposal problems (solve), the Earth will be cleaner.
- 7) If new technologies (use), there wouldn't have been so much garbage.
- 8) If manufacturing industries continue to dump hazardous and health-threatening chemicals into lakes, water bodies (stay) poisoned.
- 9) If the amount of landfill (not reduce) it will result in piles of garbage.
- 10) Unless people (make) some actions the environment pollution will not be reduced.

**19. Skills development. Speaking.** Work in pairs and ask your partner the following questions:

Would you cut down a tree if it grew in front of your house spoiling your view?	If you were the president, what would you do to protect wildlife?	If you were an animal and if you could choose, would you rather be a herbivore (plant-eating) or a carnivore (predator)?
If you could choose, which job would you take, a position in a government environment agency or in an independent organization like WWF?	If you saw your teacher litter, would you tell him/her not to do it.	How would your life change, if you could only use solar power?
If your pet could talk, what it would tell us?	If you could be a superman, what would you do to save the Earth?	What could you do to reduce the amount of rubbish if you were in the government?
If you were on safari, could you kill an animal?	If you could be an extinct animal for one day, what animal would you be?	If you were an scientist, what would you invent to protect the environment?

**20. Vocabulary.** Match the words from two columns to make phrases.

prevent	catastrophe
toxic	damaging
artificial	give off
vehicle	means of transport
absorb	cut
emit	man-made
decompose	take in
cause	bring about
crisis	poisonous
reduce	break down
harmful	stop

**21. Translation.** Translate the text in a written form.

### Landfills

Throwing daily waste/garbage in the landfills is the most popularly used method of waste disposal used today. This process of waste disposal focuses attention on burying the waste in the land. Landfills are commonly found in developing countries. There is a process used that eliminates the odors and dangers of waste

before it is placed into the ground. While it is true this is the most popular form of waste disposal, it is certainly far from the only procedure and one that may also bring with it an assortment of space.

This method is becoming less these days although, thanks to the lack of space available and the strong presence of methane and other landfill gases, both of which can cause numerous contamination problems. Landfills give rise to air and water pollution which severely affects the environment and can prove fatal to the lives of humans and animals. Many areas are reconsidering the use of landfills.

**19. Skills development. Speaking.** Make reports on the following topics.

Reuse of component parts of products – remanufacturing

Recycling

Composting and “bio-treatment”

Promoting recycling

Reducing waste by Extended Producer Responsibility: take-back programs

Methods of waste disposal

## Unit 10

### Conservation of Biodiversity

**1. Introduction.** Scan the text about biodiversity and answer the questions:

1) What is biodiversity?

2) What types of biodiversity are listed in the text?

The surrounding in which we live comprises of numerous biological organisms. Be it the birds, fishes, and trees, all of them are part of a biodiversity. What exactly does it mean? The term biodiversity was framed as a reduction of biological diversity in 1985 by E.O. Wilson. What is biodiversity and biodiversity conservation?

In simple terms, it is the variability and variety of living organisms together with ecological facilities in which they exist. Let us try to understand biodiversity as a whole and biodiversity conservation which has become a major issue in this developing age.

#### ***Types of Biodiversity***

Biodiversity comprises of genetic variability and diversity of living forms like animal microbes, plants etc. surviving in a broad range of ecosystems. It should be known that there are three interconnected hierarchical levels of biodiversity, i.e., genetic diversity, community or ecosystem diversity and species diversity.

### ***Genetic Diversity***

It comprises of the variation in the count and types of genes together with chromosomes existent in different species. Further, the magnitude of disparity in genes for specific species rises with an increase in environmental factors of the habitat and size.

### ***Species Diversity***

It highlights the variety in the number and productivity of the species within a region. Here the species richness can be defined as the count of species present per unit area. Also, the richness of a species indicates the extent of biodiversity concerning a particular site. It provides a means for comparing different sites.

### ***Ecosystem Diversity***

This type of diversity focuses on the assemblage as well as the interaction of species living together in the well-defined physical environment. It associates with different versions of habitats, biotic groups and ecological processes in a biosphere. Further, it also tells about the multiplicity within the ecosystem. You can call it Land Escape Diversity since it includes size and placement of various ecosystems.

### **Discuss the questions:**

- 1) What are the chief threats to biodiversity?
- 2) Why is it important to take active steps to conserve biodiversity?
- 3) What measures can be taken to conserve biodiversity?
- 4) Have you ever done any volunteer work to promote biodiversity conservation or directly help in a conservation project?

**2. Reading.** Find answers to questions 1-3 from the task above.

### **Conservation of Biodiversity**

Over the years, the depletion of biodiversity has been quite active. This is happening as a result of habitat loss, excessive exploitation of resources, climatic changes, diseases, pollution, poaching of animals etc. All living organisms are natural biological resources that in turn help to create conditions for life on the Earth, including human beings. Maintenance of biodiversity is of vital importance for both present and future generations. Decrease of biodiversity would result in severe ecological problems and raise moral/esthetic consequences for human populations. It can be considered as a global problem, as important as destruction of the ozone layer or increase of carbon dioxide (CO<sub>2</sub>) concentration in the atmosphere.

For the last 65 years extinction of plants and animal species has been proceeding at an elevated level. Degradation of many valuable communities has also been observed, mostly associated with the increasing impact of human activity on the biosphere.

For the last few decades, the rate of species extinction has been, on average, five times the background rate. Taking into account that the average period of existence for each species on the planet is about 4 million years, the theoretical average rate of extinction must comprise four species per year, for a total number of species of about 10 million. However, in the very near future, according even to the most modest estimates, about 50 000 species will die out each year.

Three main reasons are usually emphasized when giving arguments about the extreme importance of halting the processes of biodiversity reduction.

The first reason (or more exactly a group of reasons) is associated with the possibility of destruction of ecosystems and biospheric functions. These functions provide for optimal gas content of the atmosphere, biological purification of fresh waters, maintenance of the ability of ecosystems to transform solar energy into the chemical energy needed by living organisms, absorption of polluting substances and consequent purification of different habitats, etc. Ecologists have always connected stability of ecological systems with diversity.

The second reason to conserve biodiversity is associated with the commercial value of living organisms. Humans use plants and animals for production of food, medicine, clothes, construction materials, etc. Furthermore, the products of photosynthesis provide people with their main source of energy. Humans rely on only about thirty species of plants, in a variety of genetic forms. This number could potentially be multiplied a thousand fold by utilizing wild species of plants for food production, until their extinction.

The third reason for biodiversity conservation is moral and esthetic. In only fifty years, the human population has doubled and has now reached more than 6 billion. *Homo sapiens* is clearly the dominant species on the Earth. As a result of human activity one third of the forests has been destroyed, about one fourth of the soil cover has been exhausted, the ozone layer has been depleted, concentration of carbon dioxide keeps on increasing in the atmosphere, and hundreds of thousands species of living organisms have died out.

All the human commercial activity that negatively affects biodiversity or the state of biological resources, and indeed the biosphere, can be examined by taking Russia as an example. Over the last half century in Russia, the processes of biodiversity extinction have intensified at all levels (genetic, species, and ecosystem). Reduction of biological diversity has resulted in decrease of stability of terrestrial and aquatic ecosystems, and has caused negative changes to the environment and quality of human life.

While in a number of regions of Russia, these changes are irreversible, in others biological diversity can still be saved and restored.

Biodiversity conservation is basically aimed at protection, enhancement and scientific management of the biodiversity. To be precise, manage it at its threshold level and acquire sustainable benefits both for the present and future population.

Biodiversity conservation has three prime objectives:

- Maintain crucial ecological processes as well as life support systems.
- Preserve the variety of species.
- Make sustainable exploitation of ecosystems and species.

**3. Skills development.** Underline 2-3 key words in every paragraph. Headline the paragraphs. Retell the text.

**2. Vocabulary.** Match the term with its translation:

habitat loss	вымирание видов
excessive exploitation of resources	климатические изменения
climatic changes	истощенная почва
species extinction	чрезмерная эксплуатация ресурсов
poaching of animals	разрушение озонового слоя
biological diversity	необратимые перемены
depletion of ozone layer	биологическое разнообразие
irreversible changes	браконьерство животных
exhausted soil	утрата мест обитания
polluting substances	загрязняющее вещество

**3. Skills development.** Is the statement true or false?

1. Decrease of biodiversity can result in big ecological problems.
2. Mammals is clearly the dominant species on the Earth.
3. As a result of human activity, about one fifth of the soil cover has been exhausted.
4. People can save and restore biological diversity.
5. Biodiversity conservation has a lot of prime objectives.
6. The depletion of biodiversity is a global problem.
7. About 50 000 species have died out already.
8. People carry a moral responsibility for the state of the biosphere.

**4. Vocabulary.** Complete the table.

noun	verb
	reduce
extinction	
decrease	

	deplete
protection	
	pollute
	examine
concentration	
activity	
	purify

**5. Vocabulary.** Fill in the gaps with the words from the text.

- All living organisms are natural biological ..... that in turn help to create conditions for life on the Earth.
- For the last 65 years ..... of plants and animal species has been proceeding at an elevated level.
- Three main reasons are usually emphasized when giving ..... about the extreme importance of ..... the processes of biodiversity reduction.
- Ecologists have always connected stability of ecological systems with .....
- Humans rely on only about thirty ..... of plants, in a variety of genetic forms.
- As a result of human activity one third of the forests has been ....., about one fourth of the soil cover has been .....
- Reduction of biological ..... has resulted in decrease of stability of terrestrial and aquatic .....
- Biodiversity ..... is basically aimed at protection, enhancement and scientific management of the biodiversity.

**6. Vocabulary.** Match the word with its definition.

1. to reduce	a. to carry from one place to another
2. to contaminate	b. to change food in the stomach
3. to consume	c. to get back to
4. to solve	d. to make smaller in size, make less
5. to waste	e. to become greater or larger
6. to transport	f. to give or provide
7. to regain	g. to have or hold
8. to contain	h. to continue to live or exist
9. to supply	i. to make dirty
10. to increase	j. to find the answer to
11. to survive	k. to use without a good purpose
12. to dispose of	l. to get rid of

**7. Grammar.** Find gerund in the text “Conservation of Biodiversity”. Which forms of gerund do you know?

**8. Grammar.** Translate into Russian, pay attention to -ing forms, determine their part of speech.

- 1) The role of ecosystems in understanding the environmental challenges faced by humankind has grown significantly.
- 2) Although household hazardous waste is only a small part of municipal solid waste, it can pose problems such as catching on fire, or injuring the skin or eyes of workers coming in contact with it, or breathing its fumes.
- 3) Following a review of the historical development and refinement of the ecosystem concept, the authors explain how ecosystems function through analysis of the complex interactions between life and its physical environment.
- 4) Large quantities of packaging are generated: its composition may make it difficult to recycle, or prevent it from biodegrading.
- 5) The increasing value of the ecosystem concept is demonstrated through its applications.
- 6) The amount American communities pay for waste management is second or third only to spending on education and police protection.
- 7) The Gaia hypothesis was developed by James Lovelock in 1979. Having made a high scientific reputation, and achieved financial independence through his development of the electron capture detector, a key device in environmental analysis, he turned his attention to a unified view of earth and life sciences.
- 8) Treatment serves two purposes, either reducing waste volume or reducing its toxicity.
- 9) Most plant species are intermediate, having a combination of traits to resist environmental pressures producing stress, or disturbance, and to forage for their required resources in the face of competition from other plants.
- 10) While maintaining container strength, manufacturers from the late 1970s to 1993 reduced the weight of plastic soda bottles by 25%, the weight of glass bottles 31%, and of aluminum containers even more.
- 11) This means that water in the soil is vital for the nutrition of terrestrial plants, as well as having an equally vital role as an input to photosynthesis.
- 12) Another means to reduce food wastage is to eliminate trays in school and college cafeterias: this leads to students taking less food.
- 13) By protecting the Catskills’ from pollution and recognizing the natural water filtration capability of undeveloped land, the City avoided having to build a \$6 billion treatment plant to purify its drinking water, plus the \$300 million a year it would have cost to run the plant.

14) Environmentally preferable products are those that have been analyzed and selected on the basis of having lesser impacts on human health and the environment as compared to others that serve the same purpose.

15) For many years, a Bhopal court had criminal charges pending against Union Carbide's then Chief Executive Officer, accusing him of having consciously decided to cut back on safety and alarm systems as cost-cutting measures.

16) Although expert opinion differs, most agree that we are uncomfortably close to having used half the world's oil.

17) And recycling facilities suffer the same resistance to having them in the neighborhood as do landfills and incinerators, the not-in-my-backyard, or NIMBY, phenomenon.

18) Joseph Romm's book, *Cool Companies* notes that companies – even after having already gone through a careful examination of energy-saving opportunities – can repeat the process and find additional ways to conserve energy.

19) At one point, when he entered a field not posted as having been recently treated with organophosphate pesticide, he became very ill with sweating, trembling, and tunnel vision.

20) Despite many different materials having been proposed as biomass feedstock for biochar (including wood, crop residues and manures), the suitability of each feedstock for such an application is dependent on a number of chemical, physical, environmental, as well as economic and logistical factors.

## **METEOROLOGY**

### **UNIT 11**

#### **Atmospheric Processes and the Weather. Weather Forecast**

**1. Introduction.** Discuss the questions.

Where does the word “meteorology” come from?

Why is meteorology important to study?

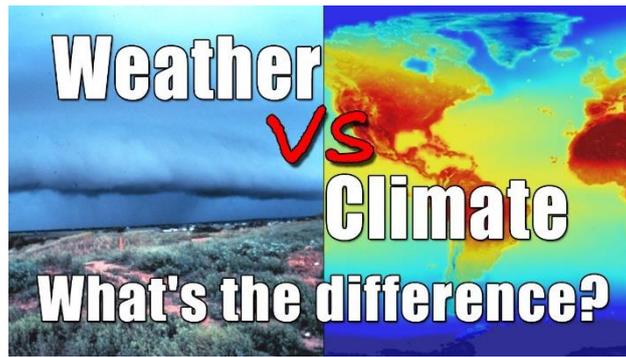
What are the different branches of meteorology?

What are the basic instruments of meteorology?

What should you study at university to get a job in meteorology?

Can a meteorology graduate work at NASA?

**2. Vocabulary.** Read the descriptions of the weather and the climate. Can you now explain the saying “*Climate is what you expect, weather is what you get.*” Then fill in the Comparison chart under the text with the phrases below.



**Weather** is a day-to-day state of the atmosphere, and its short-term variation during periods varying from minutes to weeks. People generally think of weather as the combination of temperature, humidity, precipitation, cloudiness, visibility, and wind. We talk about changes in weather in terms of the near future: "How hot is it right now?" "What will it be like today?" and "Will we get a snowstorm this week?"

**Climate** is the weather of a place averaged over a period of time, often 30 years. Climate information includes the statistical weather information that tells us about the normal weather, as well as the range of weather extremes for a location.

### Comparison Chart

BASIS FOR COMPARISON	WEATHER	CLIMATE
Meaning		
What is it?		
Represents		
Variation		
Affected by		
Assessment		
Studied by		

<p>average state of atmosphere in a region;  Climatology;  does not vary constantly;  over a long period;  everyday atmospheric condition of a particular region, as regards temperature, humidity, wind speed, etc.;  temperature and precipitation;  mountain ranges, attitudes, large water bodies;  for short term</p>	<p>minute by minute state of atmosphere in an area;  the conditions of atmosphere in a geographical location, over short period;  in what way atmosphere acts over typically long period;  Meterology;  varies constantly;  temperature, humidity, air pressure, cloudiness, precipitation etc.;  alludes to standard pattern of weather of a particular place, taken over more than 30 years.</p>
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**3. Speaking.** Discuss the following questions before reading the text:

- 1) Is there any difference between the terms “to predict” and “to forecast” (if necessary check the dictionary)?
- 2) What are the main industries affected by the weather?
- 3) Which atmospheric processes interact to produce the weather?

**4. Reading.** Put the paragraphs of the text in the correct order.

**The weather**

a) Improved scientific understanding of how the atmosphere, ocean, land and water cycles interact to produce the weather makes it increasingly possible to address the impacts of climate – defined as the average weather over a 30-year period – on people and economies. Meteorologists and climate scientists are starting to make seasonal and longer-term forecasts and to blur the boundaries between weather and climate prediction by developing “seamless weather and climate forecasts”. Climate services that draw on these forecasts will become all the more essential as human-induced climate change affects weather patterns and extreme events over the coming decades.

b) Agriculture, civil aviation and shipping, and many types of business, also depend heavily on modern weather monitoring and prediction. With access to reliable forecasts, farmers can adapt their schedules for planting, harvesting and other activities as needed. Transport is highly vulnerable to wind and storm conditions, which is why many weather stations are based at airports. Construction, energy, tourism and many other industries are also strongly affected by weather conditions.

c) We all talk about the weather, make our daily plans based on forecasts and complain when bad weather spoils our weekend. The weather does much more than determine how people dress or how they can enjoy themselves outdoors. Weather can be dangerous, causing floods, storms and heat waves that can kill or injure. Individuals and communities need to remain alert to weather conditions and forecasts in order to protect their lives and property.

Source: <https://public.wmo.int/en/resources/library/career-meteorology>

**5. Vocabulary.** Match the phrases from the text with their definition and translation.

I. to remain alert (to)	1. a greater level of understanding;	a) сохранять бдительность;
II. weather condition	2. a place where instruments record information about the weather;	b) метеоусловия, погодные условия;
III. civil aviation	3. a report on likely weather conditions for a period of time in the future;	с)
IV. weather monitoring	4. a series of weather conditions that together show how things normally happen;	метеорологическая станция;
V. weather station	5. one of two major categories of flying, representing all non-military aviation, both private and commercial;	d) климатологическая служба;
VI. weather forecast	6. the complex of meteorological characteristics in a given region;	e) мониторинг погоды;
VII. improved understanding	7. the periodic or continuous surveillance or analysis of the state of the atmosphere and climate, including variables such as temperature, moisture, wind velocity and barometric pressure;	f) заниматься решением проблемы;
VIII. to address	8. the system provided by a government or official organization for the needs of the public on climate issues;	g) тип (модель) погоды;
IX. climate service	9. to pay attention to what is happening and ready to react quickly if necessary;	h) экстремальные погодные явления;
X. to draw on	10. to try to deal with the problem or question, for example by thinking carefully about it, or by doing things to improve a situation;	i) гражданская авиация;
XI. weather pattern	11. to use something that you have gradually gained or saved	ж) прогноз погоды;
XII. extreme events	12. unexpected, unusual, severe or unseasonal weather;	к) более глубокое понимание;
		л) основываться, использовать в качестве источника

## 6. Vocabulary. Paste the words given below into the gaps.

### Observing the weather

Accurate observations about the current weather are the basis of a good weather \_\_\_\_\_. This information *is also required* to monitor the \_\_\_\_\_. \_\_\_\_\_ sources of observations are observing stations on land and at sea and upper-air soundings. Today, satellites, radar and aircraft are an increasingly \_\_\_\_\_ source of information.

There are many different instruments at an \_\_\_\_\_. Some measure temperature and humidity. \_\_\_\_\_ measure air pressure, wind speed and direction, rainfall and sunshine duration.

Weather Services of maritime countries make \_\_\_\_\_ with ships to take observations at sea and transmit them to shore. The observations are usually \_\_\_\_\_ free of charge by shipping companies in return for the instrumentation and the forecasting and warning service.

Upper-air soundings *are obtained* by \_\_\_\_\_ a balloon that carries instruments through the atmosphere. Information about pressure, temperature, humidity and wind *is sent* back to a \_\_\_\_\_.

Wind and other useful atmospheric information *is also deduced* from satellite data. Satellite meteorologists \_\_\_\_\_ the processes for turning the vast amount of data into useful information and products.

The improved \_\_\_\_\_ of weather forecasts over the last 30 years is partly due to the increase in the amount of satellite data available, along with advances made in extracting useful information for use in computer models.

Radar meteorologists have developed \_\_\_\_\_ for obtaining information about rainfall and wind from radar signals. This information shows the distribution and intensity of the rainfall and *is used* to forecast \_\_\_\_\_. Forecasters depend upon information from satellites to help \_\_\_\_\_ the location and development of weather systems, especially over the oceans. In addition, radar products provide forecasters with \_\_\_\_\_ information about the structure of rainfall. A \_\_\_\_\_ of satellite and radar images helps forecasters make detailed predictions of the weather over the next six hours or so. Such techniques are especially useful for providing warnings of \_\_\_\_\_ rainfall.

Source: <https://public.wmo.int/en/resources/library/career-meteorology>

*Words to insert:* accuracy, identify, others, tornadoes, ground station, provided, vital, arrangements, releasing, series, detailed, climate, observing site, forecast, techniques, heavy, traditional, develop

**7. Vocabulary.** Fill in the table according to the text above.

The objects of observation (the weather parameters)	Sources of observation
-	-
-	-
...	...

**8. Word formation.** Complete the table. Mark the word stress.

verb	noun	adjective/participle	profession
	observation		
			forecaster
to monitor			
		informational	
to develop			
	prediction		
		useful	
	distribution		
			sounder
to rain			

**9. Skills development. Speaking.** Make five questions to the text above and ask your partner. Take turns.

**10. Reading.** Read the text and decide which title suits best.

- 1) Steps to make a reliable weather forecast
- 2) Using computers to forecast the weather
- 3) The increasing power of computers

The behaviour of the atmosphere *is simulated* using computer models which make a detailed analysis of the state of the atmosphere at a particular time, using the latest available observations, and then apply the laws of physics to forecast what will occur.

Most computer models use a three-dimensional grid to represent the atmosphere. At each grid point, information is recorded about pressure, temperature, humidity and wind.

The starting point for making a forecast is to collect observations from around the world using the WMO Information System, which transmits surface observations,

as well as data from satellites, radar and aircraft. Once the observations *have been checked*, they *are used* to determine the atmospheric variables at each grid point at the start of the forecast.

Some of the complex processes taking place in the atmosphere cannot be fully described and represented precisely in the models so their effects have to be estimated. This *is called* “parameterization”. Research meteorologists use field experiments and physical principles to understand these processes and then develop the parameterization schemes.

The numerical models use the initial grid-point values, laws of physics regarding the behaviour of fluids and parameterization schemes to make a prediction of the change in grid-point values a short time ahead. New grid-point values are then calculated and the process is repeated. In this way, a forecast *is built up*.

With powerful computers becoming more widely available, the models *are being improved* constantly, allowing the behaviour of the atmosphere to be better modelled and resulting in ever-increasing accuracy of the forecasts. More and more data *are being used* in the modelling of the atmosphere as soon as they *are collected* (this is what is called “real time”). New modelling methods *are also being used* to improve the estimates of the confidence we should have in the forecasts.

Today, predictions made by computer models include a wide range of geographical coverage and timescales. Some models can predict weather conditions with great detail in the short range, i.e. two to three days into the future, while others can predict general weather patterns several seasons ahead.

The increasing power of computers is allowing meteorologists to benefit from multiple runs of atmospheric models to create ensemble forecasts (based on a group of forecasts) or probabilistic forecasts (e.g. there is a 30 per cent chance of rain). This is useful because sometimes small changes in initial conditions can lead to big differences in the resulting forecast.

Source: <https://public.wmo.int/en/resources/library/career-meteorology>

**11. Grammar.** Find Passive tenses in the text and fill in the table.

Present Simple	Present Continuous	Present Perfect
-	-	-
-	-	-
...	...	...

**12. Grammar.** Make the sentences from the exercise above active. Where necessary

insert the subject of the sentence.

Ex.: The behaviour of the atmosphere *is simulated* using computer models. *Using computer models a meteorologist simulates the behaviour of the atmosphere.*

**13. Grammar.** Translate the sentences into English.

a) В прошлом году большая часть опасных условий для автомобильного движения и железнодорожного сообщения были вызваны туманами, метелями, ливнями, сильными ветрами и гололедами.

b) Экстремальные погодные условия, стихийные бедствия, неспособность к адаптации к изменению климата и смягчению его последствий, а также кризис водоснабжения в последние годы признаются Всемирным экономическим форумом в качестве четырех наибольших и самых вероятных глобальных рисков для человечества.

c) Большая часть выбросов галогенированных короткоживущих субстанций (Halogenated very short-lived substances, HVSLs) будет разрушаться в тропосфере, ограничивая долю выбросов, достигающих стратосферы и вызывающих истощение озонового слоя.

d) До сих пор не установлено устойчивой связи между истощением стратосферного озона и долгосрочными изменениями приземного климата в северном полушарии.

e) Моделирование показывает, что уже к 2019 году Монреальский протокол и его поправки и корректировки принесли существенное положительное воздействие (benefits) на озон.

**14. Grammar.** Insert the correct verb.

1. Changes in tropospheric circulation driven by ozone depletion \_\_\_\_\_ to recent trends in Southern Ocean temperature and circulation

a) have contributed      b) has been contributed      c) is contributing

2. Increases in greenhouse gas concentrations \_\_\_\_\_ to lead to increases in upper-stratospheric ozone at all latitudes, with a more complex pattern of ozone changes in the lower stratosphere.

a) will predict      b) predict      c) are predicted

3. Despite these persistent model uncertainties, significant advances \_\_\_\_\_ in the understanding of processes responsible for the modeled ocean and sea ice response to ozone depletion.

a) have been made      b) have made      c) made

4. In the lower stratosphere, observed global mean cooling \_\_\_\_\_ largely \_\_\_\_\_ to stratospheric ozone changes over the past few decades.

- a) is attributed                      b) will be attributed                      c) was attributed

5. Understanding the extratropical rainfall response \_\_\_\_\_ by the quality of observational products, with little in situ data and changes in satellite products leading to substantial differences across reanalysis results.

- a) is hampered                      b) hampers                      c) is hampering

**15. Skills development.**

Give the summary of the text above using the following word combinations.

to be simulated, a detailed analysis, a three-dimensional grid, to be recorded, the starting point for, the WMO Information System, to be checked, parameterization, the numerical models, to be improved, to improve the estimates of the confidence, a wide range of, to benefit from, ensemble forecasts.

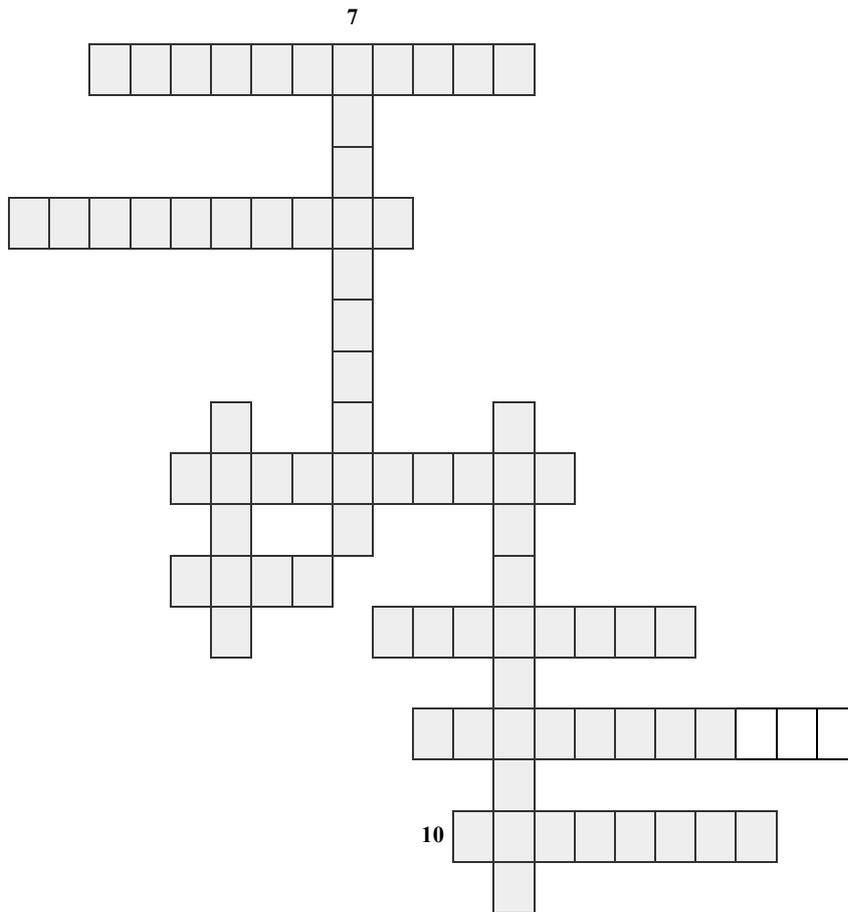
**16. Speaking.**

Prepare to speak about the difference of the weather and climate, the methods of observing the natural phenomena and the forecasting of the weather using computer models. Work one by one to make a complete story (the first student says the first sentence, the next one should continue the idea, and so on).

**17. Vocabulary.** Match the verbs in column A with the nouns in column B to make phrases.

A	B
to apply	a detailed analysis
to build up	observations
to collect	weather conditions
to develop	the laws of physics
to lead to	a forecast
to make	big differences
to model/to simulate	ever-increasing forecast accuracy
to predict	the behaviour of the atmosphere
to result in	the parameterization schemes

**18. Vocabulary.** Solve a meteorological crossword puzzle.



1. The process by which the air obtains the maximum amount of water vapour that is possible at the given temperature and pressure
2. A part of the atmosphere which has relatively uniform temperature and pressure.
3. An amount that is calculated by adding several numbers together and dividing the total by the original number of things that you added together.
4. The process in which air, being warmed close to the ground, rises.
5. Area of high atmospheric pressure that has a characteristic pattern of air circulation, with subsiding air and horizontal divergence of the air near the surface in its central region.
6. To predict weather conditions on the basis of correlated meteorological observations.
7. Air surrounding the Earth.
8. The degree or intensity of heat present in a substance or object, especially as expressed according to a comparative scale and shown by a thermometer or perceived by touch.
9. Enclosed area of low pressure revealed by the pattern of pressure distribution.

10. Water or other liquid diffused in a small quantity as vapour, within a solid, or condensed on a surface.

Choose from the following words:

*moisture, atmosphere, anticyclone, saturation, mean, depression, forecast, convection, layer, temperature*

**19. Reading.** Read the text. Prepare to answer the following questions:

- 1) What does the air contain that stimulates formation of condensation nuclei?
- 2) Why do the clouds have so many various forms?
- 3) Which level marks the base of a cloud?
- 4) Why does the convection happen?
- 5) How do the wave clouds form?
- 6) What is the main parameter for dividing cloud types?

### **Cloudforming processes**

When water in the atmosphere condenses, it first becomes visible as a cloud, if it is at some upper level, or a fog, if it rests on the ground. Clouds consist of minute water droplets, so small that they float in the air and are carried about by the air currents. If the air were absolutely clean and pure, the water vapour, on cooling, would not readily condense into droplets of visible size. But in fact the air is full of minute particles of dust, smoke and salt from sea spray, sometimes thousands of them in a cubic inch. They stimulate the formation of ice crystals and water droplets around them and are called condensation nuclei.

Clouds have a great variety of forms, from the towering thundercloud to the flat gray pall of a dull winter day. These forms arise from the different processes of cooling by which the vapour is condensed.

The main process of cooling is decompression or expansion arising from the upward movement of air. When this movement occurs in an unstable atmosphere, the air rises in large bubbles or columns. At a given height that depends on the original temperature and humidity of the rising air, condensation begins; this level marks the base of the cloud. The top of the rising column is marked by bulging cauliflower-like heads, which continue to rise until they reach a stable layer. The process is called convection, and the type of cloud, from its heaped appearance, is known as cumulus. There are usually clear spaces between such clouds, and by day the formations appear brilliancy white from the sun shining on their tops and sides. Their flat bases and shady sides are usually gray.

Vertical motion in the atmosphere is also generated by turbulence, the constant stirring of the air caused by wind and gustiness. The air goes up and down not in

large bubbles but in small filaments or cores, jumbled together. The result is not a few detached clouds but a more or less continuous layer. If there is a stable layer at some upper level the vertical motion is checked, and the air spreads out horizontally, increasing the tendency for the clouds to fuse together into a sheet.

When the terrain cools, low-level air masses also lose temperature. Such cooling gives rise to a layer of stratus cloud. For this reason, stratus clouds tend to increase by night and diminish by day. Convection clouds, however, which require surface heat for their formation, tend to build up by day and disappear at night.

When the wind blows across a range of hills, a wave-like motion of air is sometimes set up on the downstream side of the hills. In the crests of the waves air moves upward, and it may be cooled enough for clouds to form; in the troughs the air warms up and the clouds are evaporated. These clouds tend to remain in the same position relative to the hills and are called wave clouds.

Clouds are commonly grouped into physical forms that can be up to five in number: cirriform, cumuliform, cumulonimbiform, stratocumuliform, and stratiform. These designations distinguish a cloud's physical structure and process of formation.

**20. Vocabulary.** Match the phrases with the type of their formation. Use the dictionary if necessary.

*minute droplet, float, are carried about, condensation nuclei, arise from, unstable atmosphere, rising column, consist of, bulging head, heaped appearance, detached clouds, constant stirring, stratus cloud, jumbled filaments, to fuse together, gives rise to, wave-like motion, the downstream side, towering thundercloud, gray pall, given height, convection cloud.*

adj. + n. (part. + n.)	n. + n.	v. + prep.
-	-	-
-	-	-
...	...	...

**21. Vocabulary.** Insert the expressions from the text above in the table. Find the adjectives/participles describing the appearance of the listed clouds and the processes giving rise to their formation.

cloud type	appearance	conditions of formation
cumulus	-	
	-	

	...	
stratus cloud		
wave clouds		

**22. Reading.** Read the article. Prepare to answer the following questions:

1. When does condensation/evaporation take place?
2. What does the latent heat mean?
3. What does the rate of vaporizing depend on?
4. What is the main idea of each paragraph of the text? Give the name to each paragraph.

### **Condensation and evaporation**

Condensation, the direct cause of all the various forms of precipitation, occurs under varying conditions which in one way or another are associated with change in one of the linked parameters of air volume, temperature, pressure or humidity. Thus, condensation takes place when the temperature of the air is reduced but its volume remains constant and the air is cooled to dew point; if the volume of the air is increased without addition of heat; this cooling takes place because adiabatic expansion causes energy to be consumed through work, or when a joint change of temperature and volume reduces the moisture-holding capacity of the air below its existing moisture content. The key to the understanding of condensation clearly lies in the fine balance existing between these variables. Whenever the balance between one or more of them is distributed beyond a certain limit condensation may result.

The most common circumstances for condensation producing are those producing a drop in air temperature; namely contact cooling, mixing of air masses of different temperatures and dynamic cooling of the atmosphere. Contact cooling is produced, for example, within warm, moist air passing over a cold land surface. On a clear winter night strong radiation will cool the surface very quickly and this surface cooling will gradually extend to the moist lower air, reducing the temperature to a point where condensation occurs in the form of dew, fog or frost, depending on the amount of moisture involved, the thickness of the cooling air layer and the dew-point value. The latter being below 0° C, it is referred to as the hoar frost-point if the air is saturated with respect to ice. The mixing of the differing layers within a single air mass or of two differing air masses can also produce condensation. Undoubtedly the most effective cause of condensation, however, is the dynamic process of adiabatic cooling.

It's worth noting that evaporation occurs whenever energy is transported to an evaporating surface if the vapour pressure in the air is below the saturated value. The saturation vapour pressure increases with temperature. The change in state from

liquid to vapour requires energy to be expended in overcoming the intermolecular attraction of the water particles. This energy is generally provided by removing heat from the immediate surroundings causing an apparent heat loss (latent heat), and a consequent drop in temperature. The latent heat of vaporization to evaporate 1 g of water at 0° C is 600 calories. Conversely, condensation releases this heat, and the temperature of an air mass in which condensation is occurring is increased as the water vapour reverts to the liquid state. The diurnal range of temperature is often moderated by damp air condition, when evaporation takes place during the day and condensation at night.

Viewed another way, evaporation implies an addition of kinetic energy of individual water molecules and, as their velocity increases, so the chance of individual surface molecules escaping into the atmosphere becomes greater. As the faster molecules will generally be the first to escape, so the average energy (and therefore temperature) of those composing the remaining liquid will decrease and the quantities of energy required for their continued release become correspondingly greater. In this way evaporation decreases the temperature of the remaining liquid by an amount proportional to the latent heat of evaporation.

The rate of vaporizing depends on a number of factors. The two most important are the difference between the saturation vapour pressure at the water surface and the vapour pressure of the air, and the existence of a continual supply of energy to the surface. Wind velocity can also affect the evaporation rate because the wind is generally associated with the importation of fresh, unsaturated air which will absorb the available moisture.

**23. Vocabulary.** Match the suitable words from column A and B to form word combinations.

A	B
wind	energy
moisture-holding	molecules
latent	capacity
dynamic	attraction
hoar	content
moisture	air
water	loss
adiabatic	velocity
kinetic	expansion
dew	cooling

intermolecular unsaturated heat	point heat frost-point
---------------------------------------	------------------------------

**24. Vocabulary.** Try to explain the following words and word combinations in English.

contact cooling, to be worth noting, evaporation rate, to be generally associated with, unsaturated air, the key to the understanding, viewed another way, most common circumstances, to be referred to, adiabatic cooling, namely, diurnal range, to be expended.

**25. Vocabulary.** Cross out an odd word in each line. Number each line according to the headings given below.

adiabatic cooling	contact cooling	air masses mixing	wind pattern
joint	correspondingly	diurnal	moist
radiation	adiabatic	contact	condensation
wind velocity	energy supply	saturation vapour pressure	latent heat
clean	rate	cause	vapour

**Headings:** 1) Types of cooling; 2) Factors of vaporizing rate; 3) Adjectives; 4) Causes of condensation; 5) Conversion-derived words.

## Unit 12

### Types of Natural Disasters and Their Consequences

#### 1. Introduction

Natural disasters are varied and widespread. A few examples of natural disasters are: earthquakes, floods, tsunamis, hurricanes, tornadoes, volcanic eruptions, avalanches, heat waves, ice ages, meteor strikes, drought, wild fires, epidemics, famines, weather disasters and others.

What are some weather disasters that you know? Are you familiar with all of them?

#### 2. METEOROLOGICAL QUIZ

**1. What is the difference between a natural hazard and a natural disaster?**

- A) They are exactly the same.
- B) A hazard is what could happen, a disaster is after it has an impact on humans.

- C) A disaster is what could happen, a hazard is after it has an impact on humans.
- D) Hurricanes and tsunamis are natural disasters, but earthquakes and volcanoes are hazards.

**2. Which is the best way you can help prepare for natural disasters?**

- A) Watch your pets for any unusual behavior.
- B) Always carry a pint of water with you.
- C) Keep the windows of your house closed at all times.
- D) Make an emergency supply kit with your family.

**3. Why is it beneficial to be able to predict when and where natural hazards will occur?**

- A) Communities can be notified to evacuate.
- B) So that we can stop them from happening again.
- C) So that scientists know where to go in order to study them.
- D) So that we can harness their power for renewable energy.

**4. What is the center of the hurricane called?**

- A) belly
- B) eye wall
- C) eye
- D) circle

**5. Hurricanes gather \_\_\_\_\_ and \_\_\_\_\_ through contact with warm ocean waters.**

- A) sand, dust
- B) fish, plants
- C) heat, Sun
- D) heat, energy

**6. The heavy waves of a hurricane are called \_\_\_\_\_.**

- A) storm surge
- B) wave storms
- C) thunderstorms
- D) tsunamis

**7. What technologies currently exist to mitigate the effect of hurricanes?**

- A) There is currently no technology.
- B) Build buildings in circles with surrounding walls.
- C) Build buildings out of renewable resources.
- D) Elevate buildings and cities; build flood walls.

**8. What is the best way to collect data from a hurricane?**

- A) satellite images
- B) flying an airplane into the storm
- C) ocean buoys

D) ground stations

**9. Strange animal behavior, such as toads fleeing an area, could be an indicator that \_\_\_\_\_ is about to occur.**

A) a volcanic eruption

B) a tsunami

C) a hurricane

D) an earthquake

**10. What is a drought?**

A) Shortage/deficiency of water

B) Too much precipitation

C) Too much people using water

D) Strong winds

**2. Vocabulary.** Natural disasters. What causes each one? Match the words and the descriptions.

<b>Drought</b>	<b>A</b> - large amount of water that an area which is usually dry gets
<b>Flood</b>	<b>B</b> - a period of time with no rain
<b>Tornado</b>	<b>C</b> - a huge wave caused by an earthquake which flows onto land
<b>Tsunami</b>	<b>D</b> - a violent wind storm which consists of a tall column of air spinning around very fast
<b>Earthquake</b>	<b>E</b> - a violent tropical storm in which the air goes round and round
<b>Cyclone</b>	<b>F</b> - shaking of the ground
<b>Hurricane</b>	<b>G</b> - a large mass of snow falling down the side of a mountain
<b>Avalanche</b>	<b>H</b> - an extremely violent wind or storm

**3. Vocabulary.** Choose the correct word from the list below to complete the sentences: **blizzard, drought, hurricanes, tsunami, earthquakes, volcanic eruption, forest fire, desertification, avalanche, flood.**

1. During the \_\_\_\_\_ in Montroc, France, in 1999, twelve people were buried under 100,000 tons of snow five meters in depth.

2. Last year a severe \_\_\_\_\_ ruined the crops, the soil was dry as a bone.

3. In 2008 the \_\_\_\_\_ was the worst natural disaster to ever strike Thailand, the giant wave caused lots of deaths and major damage to the economy of the country.

4. The most common type of \_\_\_\_\_ occurs when magma is released from beneath the earth, which is usually accompanied by ash and gases.

5. In January \_\_\_\_\_ conditions made roads in Germany almost impassible, the snowstorm had been raging for more than a week.
6. 2011 Irene was by far one of the most destructive and deadly \_\_\_\_\_ ever to hit the USA with windspeed reaching up to 120 miles per hour.
7. The \_\_\_\_\_ was raging for two weeks in Russia, the large tract of relict trees was completely burnt away.
8. \_\_\_\_\_ takes place in drylands where the earth is fragile and vulnerable to erosion and soil degradation.
9. Annual \_\_\_\_\_ damage can be eliminated by moving houses further from the river.
10. The series of devastating \_\_\_\_\_ with a magnitude of 7.0 or above on the Richter scale caused significant damage to Japan in 2011.

**4. Vocabulary.** Put the right words into the right column:

calm, cacophony, eruption, stillness, clamor, hush, noise, tranquility, racket, roar, outbreak, rest, outburst, disorder, peace, quiet, tizzy, fever, order

Words Related to HURRICANE	Near Antonyms of HURRICANE

**5. Grammar revision.**

*a) Explain the difference of using ing-forms in the sentences below. Find more ing-forms in the text below. What parts of speech are they? Translate them into Russian.*

1. From point of origin, the storm follows a northerly direction, only **affecting** small islands.
2. Scientists have been **studying** the changes in typhoon intensity over the past several decades.
3. **Deepening** of the ocean mixed layer is likely the major reason for the sudden increase in the proportion of intense typhoons in 2001.

*b) Explain the difference of using ed-forms in the sentences below. Find more ed-forms in the text. Translate them into Russian.*

1. A tropical cyclone is a generic term **used** by meteorologists to describe a rotating, **organized** system of clouds and thunderstorms that originates over tropical or subtropical waters and has **closed**, low-level circulation.
2. Hurricanes are **categorized** 1 to 5 according to the Saffir-Simpson scale, which is **based** on wind speed.

3. The scientists **used** computer simulations to compare each factor with **observed** tropical cyclone intensities in the western North Pacific basin for each year from 1980-2015.

*c) Explain the difference of using the verb HAVE (HAS) in the sentences below:*

1. A tropical cyclone is a generic term used by meteorologists to describe a rotating, organized system of clouds and thunderstorms that originates over tropical or subtropical waters and **has** closed, low-level circulation.

2. Scientists **have** been studying the changes in typhoon intensity over the past several decades, but the reasons for the increase in typhoon intensity is still a subject of controversy, according to Wu.

3. The deepening of the ocean mixed layer is just one of many substantial changes to atmospheric and ocean circulations that **have** occurred in the western North Pacific since 2000 as a result of climate change, according to the researchers.

**6. Reading.** Read the text quickly. What is the main idea? What influences the names of natural disasters?

### **Hurricane, typhoon, cyclone: what is the difference?**

These storms all form over warm tropical waters and all can be deadly – but their origin determines their name.

Hurricanes, typhoons and cyclones may have a lot more in common than you think. They are all intense areas of low pressure and form over warm tropical waters. They can ultimately unleash deadly winds and heavy rainfall, but the defining factor for naming these storms that originate in the tropics is essentially down to where in the world they form.

Hurricanes are classed as such when a low-pressure system intensifies so that winds of 74mph (119km/h) become sustained around an area of low pressure in the North Atlantic, central North Pacific or eastern North Pacific. The power of a hurricane is rated on the Saffir-Simpson wind scale and has five categories, category 5 being the most intense. The same storm would be called a typhoon if it were to form in the north-west Pacific and would then adhere to a slightly different intensity scale to that of hurricanes. A super-typhoon would be classed as a severe hurricane on the Saffir-Simpson scale (equivalent to a category 3 hurricane) for example. The generic term cyclone or tropical cyclone is used for the South Pacific and Indian Ocean and also follows slightly different intensity scales, depending on the authorities monitoring the storm.

**7. Reading.** Read the text and give headings to part 1 and part 2.

## **Tropical cyclones**

### **Part I.**

Hurricanes and typhoons are the same weather phenomenon: tropical cyclones. A tropical cyclone is a generic term used by meteorologists to describe a rotating, organized system of clouds and thunderstorms that originates over tropical or subtropical waters and has closed, low-level circulation.

The weakest tropical cyclones are called tropical depressions. If a depression intensifies such that its maximum sustained winds reach 39 miles per hour, the tropical cyclone becomes a tropical storm. Once a tropical cyclone reaches maximum sustained winds of 74 miles per hour or higher, it is then classified as a hurricane, typhoon, or tropical cyclone, depending upon where the storm originates in the world. In the North Atlantic, central North Pacific, and eastern North Pacific, the term hurricane is used. The same type of disturbance in the Northwest Pacific is called a typhoon. Meanwhile, in the South Pacific and Indian Ocean, the generic term tropical cyclone is used, regardless of the strength of the wind associated with the weather system.

The ingredients for tropical cyclones include a pre-existing weather disturbance, warm tropical oceans, moisture, and relatively light winds. If the right conditions persist long enough, they can combine to produce the violent winds, large waves, torrential rains, and floods we associate with this phenomenon. At times, when a weather system does not meet all of these conditions, but is forecast to bring tropical storm or hurricane force winds to land in the next day or two, it is called a potential tropical cyclone in the Atlantic basin and the central and eastern North Pacific basins.

Typhoon paths follow three general directions.

Straight track (or straight runner). A general westward path affects the Philippines, southern China, Taiwan, and Vietnam.

A parabolic recurving track. Storms recurving affect eastern Philippines, eastern China, Taiwan, Korea, Japan, and the Russian Far East.

Northward track. From point of origin, the storm follows a northerly direction, only affecting small islands.

According to the World Meteorological Organization recommendations, tropical cyclones are classified by the maximum sustained wind speeds near the centre. Hurricanes are categorized 1 to 5 according to the Saffir-Simpson scale, which is based on wind speed.

In the Atlantic, hurricane season officially runs from June 1 to November 30. Ninety-seven percent of tropical cyclone activity occurs during this time period. However, there is nothing magical about these dates. Hurricanes can and do occur outside of this six month period.

## **Part II.**

Changes to the uppermost layer of Earth's oceans due to rising temperatures are likely causing an increase in intense Pacific Ocean typhoons, suggesting strong typhoons may occur more frequently than scientists project in the coming decades, according to new research.

The surface layer of the ocean, known as the ocean mixed layer, is approximately 200 meters (656 feet) deep on average. This layer is constantly exchanging gases with the atmosphere and experiencing mixing caused by winds, heat transfer, evaporation and changes in salinity.

Understanding how climate variability within a climate system contributes to the observed increase in the proportion of intense typhoons helps scientists understand the hazards posed by devastating storms in the north Pacific Ocean, especially as the ocean and atmosphere continue to warm, according to the researchers.

Scientists have been studying the changes in typhoon intensity over the past several decades, but the reasons for the increase in typhoon intensity is still a subject of controversy, according to Wu.

In the new study, Wu and his team examined the contributions of various factors controlling typhoon intensity change, such as sea surface temperatures, the temperature of outward flowing air and water, ocean mixed layer depth, and vertical wind shear, as well as shifts in the tropical cyclone tracks. They used computer simulations to compare each factor with observed tropical cyclone intensities in the western North Pacific basin for each year from 1980-2015.

After quantifying the contribution of each environmental factor to tropical cyclone intensity, they determined that the increase in the proportion of intense typhoons was largely due to a deepening of the ocean mixed layer. This deepening is in turn caused by variations in ocean and atmospheric conditions.

The deepening of the ocean mixed layer is just one of many substantial changes to atmospheric and ocean circulations that have occurred in the western North Pacific since 2000 as a result of climate change, according to the researchers. Deepening of the ocean mixed layer is likely the major reason for the sudden increase in the proportion of intense typhoons in 2001, Wu said.

Because previous studies have not accounted for ocean mixed layer depth in their projections, the authors conclude that future typhoons in the North Pacific may be increasingly intense, and to an even greater degree than previously thought.

**Comprehension check:**

**A) Answer the following questions on the text:**

1. What are main characteristics of a tropical cyclone?
2. What is the tropical cyclone classification based on?
3. What are the ingredients for tropical cyclones occurrence?
4. When is the hurricane season?
5. What causes the typhoon intensity change according to Wu?

**B) Are the statements true or false?**

1. Hurricanes and typhoons are different weather phenomena.
2. Typhoon paths follow three general directions.
3. The weakest tropical cyclones are called typhoons.
4. Hurricanes can and do occur outside of the hurricane season period.
5. Future typhoons in the North Pacific may be increasingly intense, and to an even greater degree than previously thought.

**8. Grammar revision.** Make Participle I or Participle II of the verbs in brackets. Translate sentences into Russian.

1. .... (to know) also as cyclones and typhoons in other parts of the world, hurricanes cause high winds, flooding, heavy rain, and storm surges (high tidal waves).
2. Since 2002, there have been a number of initiatives and accomplishments (to have) ..... a significant impact on the World Weather Watch.
3. The current systems (to utilize) ..... the Global Positioning System, have resulted in continued improvement in data quality and ease of operation.
4. The reason for the dramatic reduction has been effective warnings and timely evacuation from coastal areas (to inundate) ..... by storm surge.
5. Tropical cyclones are ideal subjects for study from (to instrument) ..... aircraft.
6. This descending air reduces water vapor and cloud formation (to result in) ..... light winds and stable weather.
7. Since 1959 meteorological satellites have provided an overview of the atmosphere's cloud patterns, (to serve) ..... among other things as an early warning and detection systems for hurricanes, typhoons, and tropical cyclones.
8. The World Weather Watch, (to organize) ..... by the World Meteorological Organization, collects and disseminates information on a global basis.

9. The Beaufort wind force scale is an empirical measure that relates the mean wind speed to conditions (to observe) ..... at sea or on land.

10. Scientists have used 3D printing to create (to vary) ..... shapes of snowflakes and study how their individual structure affects their behaviour.

**9. Skills development.** Render the text into English.

**Стихийные бедствия метеорологического характера (ураганы, бури, смерчи, снежные заносы).**

**Ураганы, бури, смерчи** - это чрезвычайно быстрое и сильное, нередко большой разрушительной силы и значительной продолжительности движение воздуха.

**Ураган** - спиралевидное движение воздушных масс разрушительной силы. Скорость ветра может достигать 125 км/час и более. По своему пагубному воздействию ураганы не уступают землетрясениям. Ураганный ветер разрушает прочные и сносит легкие строения, опустошает поля, обрывает провода, валит столбы линий электропередачи и связи, ломает и выворачивает с корнями деревья, топит суда, повреждает транспортные магистрали.

**Бури** - разновидность ураганов и штормов.

**Смерч** - циклоническая система ветров. Возникает обычно в грозовом облаке и затем распространяется в виде рукава к поверхности суши или моря. Высота смерча достигает иногда километра, диаметр у поверхности земли - от нескольких десятков до сотен метров. Это восходящие вихри быстро вращающегося воздуха, имеющие вид темного столба диаметром от нескольких метров до сотен метров с вертикальной, иногда и загнутой осью вращения. Смерч как бы "свешивается" из облака к земле в виде гигантской воронки. Его воронка вращается с огромной скоростью (до 800 км/ч). Это вращение, направленное по спирали вверх, служит причиной значительных разрушений особенно в городах, поселках. Внутри его давление всегда пониженное, поэтому туда засасываются любые предметы. Скорость перемещения смерча до 80 км/ч, по времени его длительность в среднем до получаса, но зарегистрированы и более длительные смерчи.

**10. Reading.**

A. Read the text and fill in the chart with the necessary information.

B. Put at least one question to every paragraph of the text.

C. Translate the last 4 paragraphs into Russian using the dictionary.

## **Tornado**

A tornado is a rapidly rotating column of air that is in contact with both the surface of the Earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. The windstorm is often referred to as a twister, whirlwind or cyclone, although the word cyclone is used in meteorology to name a weather system with a low-pressure area in the center around which winds blow counterclockwise in the Northern Hemisphere and clockwise in the Southern. Tornadoes come in many shapes and sizes, and they are often visible in the form of a condensation funnel originating from the base of a cumulonimbus cloud, with a cloud of rotating debris and dust beneath it. Most tornadoes have wind speeds less than 110 miles per hour (180 km/h), are about 250 feet (80 m) across, and travel a few miles (several kilometers) before dissipating. The most extreme tornadoes can attain wind speeds of more than 300 miles per hour (480 km/h), are more than two miles (3 km) in diameter, and stay on the ground for dozens of miles (more than 100 km).

Various types of tornadoes include the multiple vortex tornado, landspout, and waterspout. Waterspouts are characterized by a spiraling funnel-shaped wind current, connecting to a large cumulus or cumulonimbus cloud. They are generally classified as non-supercellular tornadoes that develop over bodies of water, but there is disagreement over whether to classify them as true tornadoes. These spiraling columns of air frequently develop in tropical areas close to the equator and are less common at high latitudes. Other tornado-like phenomena that exist in nature include the gustnado, dust devil, fire whirl, and steam devil.

Tornadoes occur most frequently in North America, particularly in central and southeastern regions of the United States colloquially known as tornado alley, as well as in Southern Africa, northwestern and southeast Europe, western and southeastern Australia, New Zealand, Bangladesh and adjacent eastern India, and southeastern South America. Tornadoes can be detected before or as they occur through the use of Pulse-Doppler radar by recognizing patterns in velocity and reflectivity data, such as hook echoes or debris balls, as well as through the efforts of storm spotters.

There are several scales for rating the strength of tornadoes. The Fujita scale rates tornadoes by damage caused and has been replaced in some countries by the updated Enhanced Fujita Scale. An F0 or EF0 tornado, the weakest category, damages trees, but not substantial structures. An F5 or EF5 tornado, the strongest category, rips buildings off their foundations and can deform large skyscrapers. The similar TORRO scale ranges from a T0 for extremely weak tornadoes to T11 for the most powerful known tornadoes. Doppler radar data, photogrammetry, and ground swirl patterns (trochoidal marks) may also be analyzed to determine intensity and assign a rating.

A tornado is not necessarily visible; however, the intense low pressure caused by the high wind speeds (as described by Bernoulli's principle) and rapid rotation (due to cyclostrophic balance) usually cause water vapor in the air to condense into cloud droplets due to adiabatic cooling. This results in the formation of a visible funnel cloud or condensation funnel.

There is some disagreement over the definition of a funnel cloud and a condensation funnel. According to the Glossary of Meteorology, a funnel cloud is any rotating cloud pendant from a cumulus or cumulonimbus, and thus most tornadoes are included under this definition. Among many meteorologists, the 'funnel cloud' term is strictly defined as a rotating cloud which is not associated with strong winds at the surface, and condensation funnel is a broad term for any rotating cloud below a cumuliform cloud.

Tornadoes often begin as funnel clouds with no associated strong winds at the surface, and not all funnel clouds evolve into tornadoes. Most tornadoes produce strong winds at the surface while the visible funnel is still above the ground, so it is difficult to discern the difference between a funnel cloud and a tornado from a distance.

Occasionally, a single storm will produce more than one tornado, either simultaneously or in succession. Multiple tornadoes produced by the same storm cell are referred to as a "tornado family". Several tornadoes are sometimes spawned from the same large-scale storm system. If there is no break in activity, this is considered a tornado outbreak (although the term "tornado outbreak" has various definitions). A period of several successive days with tornado outbreaks in the same general area (spawned by multiple weather systems) is a tornado outbreak sequence, occasionally called an extended tornado outbreak.

A multiple-vortex tornado is a type of tornado in which two or more columns of spinning air rotate about their own axis and at the same time around a common center. A multi-vortex structure can occur in almost any circulation, but is very often observed in intense tornadoes. These vortices often create small areas of heavier damage along the main tornado path. This is a phenomenon that is distinct from a satellite tornado, which is a smaller tornado which forms very near a large, strong tornado contained within the same mesocyclone. The satellite tornado may appear to "orbit" the larger tornado (hence the name), giving the appearance of one, large multi-vortex tornado. However, a satellite tornado is a distinct circulation, and is much smaller than the main funnel.

<b>Characteristics of tornado</b>	
<b>Types of tornado</b>	

<b>Places of origin</b>	
<b>Strength scales</b>	

**11. Speaking.** Role play. Read the recommendations below and continue a conversation between the journalist and Professor Johnson a specialist on tornadoes.

**Journalist:** Knowing what to do when you see a tornado, or when you hear a tornado warning, can help protect you and your family. During a tornado, people face hazards from extremely high winds and risk being struck by flying and falling objects. After a tornado, the wreckage left behind poses additional injury risks. Although nothing can be done to prevent tornadoes, there are actions you can take for your health and safety. Our guest today is Professor Johnson who studies tornadoes and we have some questions to discuss.

**Professor Johnson:** .....

Useful language:

First of all.... Second .... Next .... Besides ....

It is very important / vital / recommended to ....

Be careful and keep abreast of the latest ....

Make sure you ....

You should ... in case ....

Do not venture to ....

Keep in mind that ....

# Be Ready! Tornadoes

[www.cdc.gov/phpr/infographics.htm](http://www.cdc.gov/phpr/infographics.htm)

**Get out!**  
Don't stay in a mobile home during a tornado. Find a sturdy building or seek shelter outside.



**Watch out!**  
Most fatalities and injuries are caused by flying debris.



**Look up!**  
If you see any of these danger signs, take shelter immediately:

- a dark or green colored sky
- large, dark, low-lying cloud
- large hail
- loud roar similar to a freight train

**Stay tuned!**  
Listen to local radio and TV stations for weather updates. Take shelter if a tornado warning is issued.

**Tornado watch:**  
Tornadoes are possible. Be alert to changing conditions.

**Tornado warning:**  
A tornado has been sighted or indicated by weather radar. Take shelter immediately.



**Be cautious!**  
Do not try to outrun a tornado. Find a sturdy building to take shelter or stop your car, put your head below the windows, and cover your head.



**Take shelter!**  
The safest place is the interior part of a basement or an inside room, without windows, on the lowest floor.



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## Unit 13

### Severe Weather Forecasting, Early Warning Systems and Risk Reduction

#### **Introduction**

Weather hazards and related events such as hurricanes, heat waves, cold waves, windstorms, floods, and droughts jointly cause more economic damage and loss of life than other natural disasters. In recent decades such damage has shown a growing trend, and climate change may make such events even more dangerous. Weather extreme also contributes to impacts on food security, food price volatility and health. Strengthening weather and climate information and decision support systems is a key aspect of implementing the priority to enhance early warning systems highlighted under the Hyogo Framework.

The Hyogo Framework for Action, which was adopted by the World Conference on Disaster Reduction in Hyogo, Japan in 2005, identified five priority areas:

1. Ensure that disaster risk reduction (DRR) is a national and local priority with a strong institution basis for implementation.
2. Identify, assess and monitor disaster risks and enhance early warning.
3. Better knowledge management for building a culture of safety.
4. Reducing the underlying risk factors.
5. Enhance preparedness for an effective response.

The principle sources of information for warning systems are the International Strategy for Disaster Reduction (ISDR), the World Meteorological Organization (WMO) and countries that have implemented early warning systems successfully.

**1. Vocabulary.** Translate the “noun + noun” chains.

disaster risk management, warning message, climate change, hazard probability, disaster mitigation, community vulnerability, population segments, weather events, forecasting and warning systems, communication networks, warning services.

**2. Vocabulary.** Which parts of speech are the following words? Which words can be used as different parts of speech (the notion of conversion)?

Effectively, empower, past, immediately, lower, afterwards, likely, approach, vulnerability, respond, occurrence, essential, likelihood, individual, sound, accurate, appropriate, minimize, timely, understanding.

**3. Word formation.** Complete the chart.

<b>Verb</b>	<b>Noun</b>
respond	
occur	
manage	
lose	
cause	
consider	
describe	
monitor	
expose	
gain	
generate	
reinforce	
reduce	
warn	
ensure	

**4. Reading.** Read the text and find: A) sentences with modals, B) sentences with infinitives, and translate them.

**The Role of NMHSs (National Meteorological and Hydrological Services) in Early Warning and Disaster Management**

The role of NMHSs in early warning and disaster risk management is critical since so many natural hazards, which cause floods, heat waves, cold waves, wind storms, wildfires, droughts, landslides, epidemics and the resulting social and economic losses are weather-related and likely to become more common due to climate change. A systematic approach to managing the “risks” associated with disasters can prevent or mitigate their impact. The process must consider the likely effects of natural hazards and the measures by which they can be minimized.

The concept of disaster risk is used to describe the likelihood of harmful consequences arising from the interaction of natural hazards and the community. Two elements are essential in the formulation of disaster risk: the probability of occurrence of a hazard, and the vulnerability of the community to that hazard.

$$\text{Risk} = \text{Hazard Probability} \times \text{Vulnerability}$$

A closer look at the nature of hazards and the notions of vulnerability allows for a better and more comprehensive understanding of the challenges posed by disaster mitigation:

**A) Nature of hazard.** By seeking to understand hazards of the past, monitoring of the present, and prediction of the future, a community or public authority is poised to minimize the risk of a disaster. The NMHSs play a key role in this aspect of risk management of weather-related natural disasters.

**B) Notions of Vulnerability.** The community vulnerability is the susceptibility and resilience of the community and environment to natural hazards. Different population segments can be exposed to greater relative risks because of their social and economic conditions. Reducing disaster vulnerability requires increasing knowledge about the likelihood, consequences, imminence and presence of natural hazards, and empowering individuals, communities and public authorities with that knowledge to lower the risk before severe weather events occur, and to respond effectively immediately afterwards.

There must be a sound scientific basis for predicting and forecasting hazards and reliable forecasting and warning systems that operate 24 hours a day. Continuous monitoring of hazard parameters and precursors is essential to generate accurate warnings in a timely fashion. Warning services for different hazards should be coordinated where possible to gain the benefit of shared institutional, procedural and communication networks.

Warnings must reach those at risk. Clear messages containing simple, useful information are critical to enable proper responses that will help safeguard lives and livelihoods. Regional, national and community level communication systems must be pre-identified and appropriate authoritative voices established. The use of multiple communication channels is necessary to ensure as many people as possible are warned, to avoid failure of any one channel, and to reinforce the warning message.

**5. Grammar.** Translate the sentences and define the function of the underlined infinitive.

1. A warning system must empower individuals, communities and businesses to respond timely and appropriately to hazards in order to reduce the risk of death, injury, property loss and damage.

2. Warnings must get the message across and stimulate those at risk to take action.

3. To identify and evaluate the weather information needs of the users, NMHSs need to build relationships and work in partnership with users in both the public and private sectors.

4. Some meteorologists, like forensic or consulting meteorologists, are hired for their expertise in the field to help other professionals.

5. If the hurricane climatology and the Multi-Decadal Mode prove to be reliable guides, we may expect the first decade or two of the 21<sup>st</sup> Century to produce as many of the most damaging major hurricanes annually as the last 5 years have.
6. Sometimes, as happened in Hurricane Emily of 1993, models and observations combine to give forecasters particularly clear insight into the meteorological situation, so that they can exclude large sections of coastline, perhaps hundreds of miles long, from the warning area and save the economy as much as \$100M.
7. Since the number of air molecules above the surface increases, there are more molecules to exert a force on that surface.
8. The wavelike formation observed in the cloud base was found to be associated with atmospheric waves being channelled along the cloud base.
9. The term dust storm is more likely to be used when finer particles are blown long distances, especially when the dust storm affects urban areas.
10. The purpose of preparing and delivering services to users is to enable them to make better decisions by using weather and climate information.

**6. Reading.** Look through the text (not more than 3 min.) and give the main idea.

### **Development of an effective warning program**

Since preparing and issuing warnings of hazardous weather is one of the most essential activities of NMHSs, it is crucial to develop an effective warning program. NMHSs' staff in charge of forecasting and public weather service provision should be involved in the development of the program as they are aware of the realities on the ground in terms of strengths and limitations of their Service. To be successful, a warning program strives to ensure that everyone at risk must:

- Receive the warning,
- Understand the information presented,
- Believe the information,
- Personalize the information,
- Make correct decisions,
- Respond in a timely manner.

The ideal warning process has to take into account each of the above components to be successful. It takes training and planning as well as strong collaboration with other

partner agencies such as the disaster management and media, to implement a warning program.

**7. Reading.** Read the text and answer the following questions:

1. What does CMA stand for? What does it issue?
2. What is CMA responsible for?
3. Why is it important to have consistent warnings between neighboring countries?
4. What is meteoalarm? Who is it aimed at? What does it focus on?
5. What colour corresponds the highest level of risk?
6. What does yellow color mean?

### **Coordination of Warning and Response Messages**

Ensuring that warning information is consistent across different departments is important, especially when each has a joint, but differentiated responsibility for issuing warnings. The China Meteorological Administration (CMA), for example, issues fourteen categories of warning signals: tropical cyclones, heavy rain, heavy snow, cold surges, strong wind, dust, heat waves, droughts, thunder and lightning, hail, frost, heavy fog, haze, icy roads. In addition, the Shanghai Meteorological Service (SMS) issues ozone warnings and it is in the process of developing health warnings for specific weather-sensitive diseases.

The CMA is responsible for creating weather disaster prevention planning for multi-agency implementation. For example, emergency response categories (I, II, and III) have been developed for flood and typhoon prevention based on weather warning categories (blue, yellow, orange and red).

This coordinated approach ensures that warnings have the authority of both the meteorological service and the agencies responsible for the particular sector affected. Similarly, it is important that warnings are consistent between countries that share common borders or are part of an economic community with considerable cross border exchange of people, goods and services. This has been successfully developed in Europe through an initiative called **meteoalarm** ([www.meteoalarm.eu](http://www.meteoalarm.eu) is the website that integrates all important severe weather information originating from the official National Public Weather Services across a large number of European countries. The participating countries are Austria, Belgium, Switzerland, Cyprus, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Greece, Croatia, Hungary, Ireland, Iceland, Italy, Luxemburg, Latvia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Sweden, Slovenia, Slovakia, United Kingdom).

Meteoalarm is aimed at anyone travelling through Europe. Pictograms and colour-coded maps of Europe show at a glance where the weather might be, or soon become,

dangerous. Gales, torrential rain, snow and ice, thunder and lightening, fog, and extreme temperatures are all indicated as well as weather conditions that could lead to increased risk, such as storm surges and high waves, forest fires, and avalanches. The level of risk is colour coded.

<b>Green</b>	Is your country colored green? Then there is nothing to worry about.
<b>Yellow</b>	Yellow means potential danger. The weather is unlikely to be extreme but care is called for in activities that are dependent on the weather. Keep an eye on the information.
<b>Orange</b>	<b>Orange means danger. There is severe weather that may cause damage or accidents. Keep in mind that the weather brings risks. Be careful and keep abreast of the latest developments in the weather. Take heed of all advice given by the authorities.</b>
<b>Red</b>	<b>Red means great danger from extremely severe weather. Major damage and accidents are likely. In many cases with threat to life and limb, over a wide area. Be extremely careful, pay constant attention to bulletins and obey the instructions and advice given by the authorities under all circumstances. Keep in mind that exceptional measures may be taken.</b>

Developing a common weather awareness is a challenge for many countries; however the experience with Meteoalarm is generally positive linking the underlying national warning information into a regional framework. At this stage, Meteoalarm focuses mostly on meteorological phenomena, rather than issuing flood warnings for example.

**8. Reading and Speaking.** Read and translate the text. Make at least one question to each paragraph of the text. Why is hurricane Katrina reported as one of the strongest storms to hit the U.S. coast? Give your ideas. Give the summary of reasons and consequences of its occurrence.

## Why It Is So Hard To Predict Hurricanes

Our models of where storms are going have gotten much better, but we can't really predict how strong they'll be once they get there.

### HURRICANE KATRINA

At 6:10 am on August 29, 2005, the eye of Hurricane Katrina made landfall in Buras-Triumph, LA., going on to devastate much of the Gulf Coast. In a report only a few months later, the National Oceanic and Atmospheric Administration (NOAA) called it one of the strongest storms to hit the U.S. coast in the last 100 years.

Katrina didn't start out that way. After entering the Gulf of Mexico, it intensified rapidly, going from a Category 1 hurricane when it passed through southern Florida on August 25, 2005, then gaining momentum and jumping from a Category 3 all the way up to Category 5 status over the span of about a day later that weekend.

Thanks to evolving technology, including better satellite data and faster computers, as well as an increasing knowledge of what actually goes on inside a hurricane, the computational models we use to predict hurricanes have gotten much better. Meteorologists have gotten reasonably good at figuring out where a tropical cyclone is headed. What we're not so good at is figuring out how strong it's going to be when it gets there.

Hurricane prediction involves a number of different computer-generated models. Each is a little bit different, and has different strengths. "It's not a straight mass equation, where you may solve for x and that's the answer," explains John Cangialosi, a hurricane specialist at NOAA's National Hurricane Center. "There are a lot of assumptions being made. There is no exact answer."

Current models are fairly accurate at forecasting the track of a hurricane--that is, where it's going to go. For this, we can use global dynamical models, which take real-time atmospheric data from all over the world and solve physics equations to predict what will happen next.

"We can come within 80 miles or so. That's actually pretty good," says Cary Mock, a geography professor at the University of South Carolina.

These global models are good at figuring out where things are generally heading, but they don't have the resolution to tell you much about the hurricane itself. For instance, they can't predict very well when a storm like Katrina will suddenly intensify. "It can't really tell you how strong the hurricane is even at the current time," Cangialosi says.

## KATRINA DEVASTATION IN PORT SULPHUR, LA.

When it comes to modeling the intensity of a particular storm, we tend to turn to less sophisticated statistical models. They compare basic information from the current storm, like location and time of year, to historic storm behavior, and spit out an averaged prediction. Cangialosi says a statistical model is "not trying to resolve and model what *this storm* is going to do, but it will tell us... a storm in this location and this environment, on average it will do this." They're quicker to run and don't require as much data or computational power.

It's still somewhat mysterious. We observe them, but we don't actually understand them to a large factor. There are more complex forecast models, and they are generally more accurate than their simple counterparts. "I'm amazed we can shove a whole world's worth of weather data into a computer," Mock says. "We couldn't do that 15 years ago." One drawback: they can take hours to run on a supercomputer. So when storms pop up or change quickly, researchers have to rely on quicker statistical models that can crunch the numbers fast.

Another reason we can't run more accurate, dynamic models on the intensity of hurricanes is that we don't entirely understand how hurricanes function. "It's still somewhat mysterious," Cangialosi says. "We observe them, but we don't actually understand them to a large factor."

For example, it was only recently that we learned that the wall around the hurricane's eye can deteriorate, and a new one will form around it. This can affect the intensity of the hurricane, but not always in the same way. Sometimes it makes the hurricane stronger, sometimes weaker. "Those are the things we can't quite model. We can't take into account all the dynamics of the eye wall," Mock says.

That's why hurricane forecasting still relies not just on a computer crunching numbers, but on human intervention - an actual forecaster who looks at the details of the storm and determines whether the model seems to be painting an accurate picture that makes sense based on the conditions. And that's why sometimes, a storm predicted to be a doozy barely seems like a blip in the radar, or vice versa.

We have begun to learn a little bit more about hurricane dynamics by flying planes into the eye of the storm. Besides sounding badass (INTO THE STORM, FOR SCIENCE!), sending aircraft straight to the source to drop weather balloons and sensors to collect data on aspects like wind direction, pressure, water vapor can help us learn more about how storms work.

### 9. Vocabulary. Translate word combinations into English.

циклоническая система ветров, движение воздуха разрушительной силы, ураганный ветер, грозовое облако, воронка, восходящие вихри, значительные

разрушения, подавать штормовое предупреждение, безопасное место, прогнозирование возникновения стихийных бедствий.

**10. Grammar revision.** Translate the sentences into English.

1. Каждому стихийному бедствию присущи свои особенности, характер поражений, объем и масштабы разрушений, величина бедствий и человеческих жертв.

2. Одна из главных проблем, которая выходит сегодня на первый план - правильное прогнозирование возникновения и развития стихийных бедствий, заблаговременное предупреждение органов власти и населения о приближающейся опасности.

3. Заблаговременная информация дает возможность провести предупредительные работы, привести в готовность силы и средства, разъяснить людям правила поведения.

4. Все население должно быть готово к действиям в экстремальных ситуациях, к участию в работах по ликвидации стихийных бедствий, уметь владеть способами оказания первой медицинской помощи пострадавшим.

5. Знание причин возникновения и характера стихийных бедствий позволяет при заблаговременном принятии мер защиты, при разумном поведении населения в значительной мере снизить все виды потерь.

**11. Reading.** Read the text. What is the main idea of each paragraph of the text? Give the name to every paragraph.

**Why Are Tornadoes So Hard To Predict?**

People in the path of a tornado typically get only 10 minutes of warning. Why?

Sixteen minutes before a tornado touched down in Newcastle, Okla., yesterday, the U.S. Storm Prediction Center sent a warning to the area. That heads-up was longer than the average warning time of 8 to 10 minutes.

Why are tornado predictions so short-term, especially compared to other predictions we're familiar with, such as weather forecasts or hurricane warnings?

Hurricanes and blizzards show up on satellites days beforehand, but the conditions that favor tornados appear much more quickly and unexpectedly, the Associated Press reported in 2011. Tornadoes are just made of much finer print, so to speak. Their paths are smaller and they last for shorter periods of time, so predicting any particular tornado requires a fine-grain understanding that's more difficult for scientists.

Instead, the Storm Prediction Center issues tornado watches hours ahead of time that cover very broad areas. In 2011, the Associated Press reported on a watch that included 14 states.

The Storm Prediction Center looks for patterns in temperature and wind flow that create certain levels of moisture, instability, lift and wind shear, according to the center's extensive [frequently asked questions page](#). Even then, its predictions may be uncertain because tornado conditions don't always look the same. A number of different scenarios can result in tornados, while similar scenarios may not always produce tornados. Slight changes that meteorologists can't currently measure may tip a thunderstorm to form a tornado—or not, Storm Prediction Center warning coordinator Greg Garbin told [Scientific American](#) in 2011.

Researchers are now working on forecasts that apply to areas smaller than a state, but larger than a county, Garbin said. With future improvements, meteorologists could get about an hour's warning on tornados, but not much more. Researchers just can't read the fine print that closely.

### **Comprehension check:**

#### **A) Are the following statements true or false?**

1. The conditions that favor tornados appear much more quickly and unexpectedly compared to those of hurricanes and blizzards.
2. People in the path of a tornado typically get 30 minutes of warning.
3. Predictions of tornado may be uncertain because tornado conditions don't always look the same.
4. With future improvements, meteorologists could get about an hour's warning on tornados, but not much more.
5. Predicting any particular tornado requires a fine-grain understanding that's not so difficult for scientists.

#### **B) Put the words given below into the gaps.**

1. Sixteen minutes before a tornado touched down in Newcastle, Okla., yesterday, the U.S. Storm Prediction Center sent ..... to the area.
2. Hurricanes and blizzards show up on ..... days beforehand.
3. Tornado ..... are smaller and they last for shorter periods of time.
4. The Storm Prediction Center looks for patterns in temperature and ..... that create certain levels of moisture, ....., lift and wind .....
5. Slight changes that meteorologists can't ..... measure may tip a thunderstorm to form a tornado.
6. Researchers are now working on ..... that apply to areas smaller than a state, but larger than a county.

**Words to put into gaps:** paths, a warning, wind flow, currently, shear, satellites, instability, forecasts.

**12. Reading.** Put the parts of the text into the right order. Give the main idea of the text.

### **Hurricane Sandy: Wind Shear**

(1) High wind shear can remove some of the heat being released by a hurricane or blow the top portion of the hurricane away from the bottom, causing its vortex to tilt. Such a tilt will make the hurricane, which runs on heat, less efficient.

(2) During hurricanes, the vertical measurement is more important. Our active weather is confined between the Earth's surface and the top of the troposphere, the lowest layer of Earth's atmosphere. Hurricanes, which fill this entire vertical space, are steered by average wind.

(3) Reports said that though Hurricane Sandy battled high wind shear on Saturday, wind shear is forecasted to decline and the hurricane may strengthen.

(4) Wind shear usually comes up when you talk about how a hurricane weakens. The term refers to changes in wind speed or direction over a short distance and can be measured either vertically or horizontally.

**13. Grammar revision.** Translate sentences into Russian paying attention to the underlined grammar structures.

1. It was in this environment that the WMO Information System initiative was developed.

2. In addition to being gathered in real time, radar measurements give a more complete analysis of the boundary layer by sending out vertical and horizontal impulses to log if snow, rain or insects are present.

3. If the weight of mercury is less than the atmospheric pressure, the mercury level in the glass tube will rise (high pressure).

4. Air flow in a high pressure system is opposite that of a low pressure system.

5. The more closely the isobars are spaced together, the stronger the pressure change (pressure gradient) is over a distance.

6. Pressure, much like convection, is an important meteorological principle that is at the root of large-scale weather systems as diverse as hurricanes and bitter cold outbreaks.

7. It is the first time that lightning has been included in the official WMO Archive of Weather and Climate Extremes, which is maintained by the WMO Commission for Climatology and documents details of records for heat, cold, wind speed, rainfall and other events.

8. Having established that heat waves have grown, Skinner is now looking ahead, understanding what kind of heat waves we can expect twenty years hence, and pinpointing which parts of the world are most vulnerable.
9. After quantifying the contribution of each environmental factor to tropical cyclone intensity, they determined that the increase in the proportion of intense typhoons was largely due to a deepening of the ocean mixed layer.
10. The power of a hurricane is rated on the Saffir-Simpson wind scale and has five categories, category 5 being the most intense.
11. The same storm would be called a typhoon if it were to form in the north-west Pacific and would then adhere to a slightly different intensity scale to that of hurricanes.
12. A super-typhoon would be classed as a severe hurricane on the Saffir-Simpson scale (equivalent to a category 3 hurricane).

#### **14. Speaking and Writing.**

**Task 1.** Imagine yourself to be a journalist of the Guardian who was given the task to make a report about the hurricane that has recently hit the coast of the USA. Use the ideas from the texts of Unit 2.

**Task 2.** All major hurricanes are given human names (for example Katrina). Choose 3 hurricanes of this kind and make a little report about each of them giving interesting facts and figures.

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