

UNIT 8

PHYSICS+OTHER SCIENCES

“The future of research is interdisciplinary, and it will quickly take us into areas that today we cannot even foresee...”

Michael Tanner

Learning Objectives

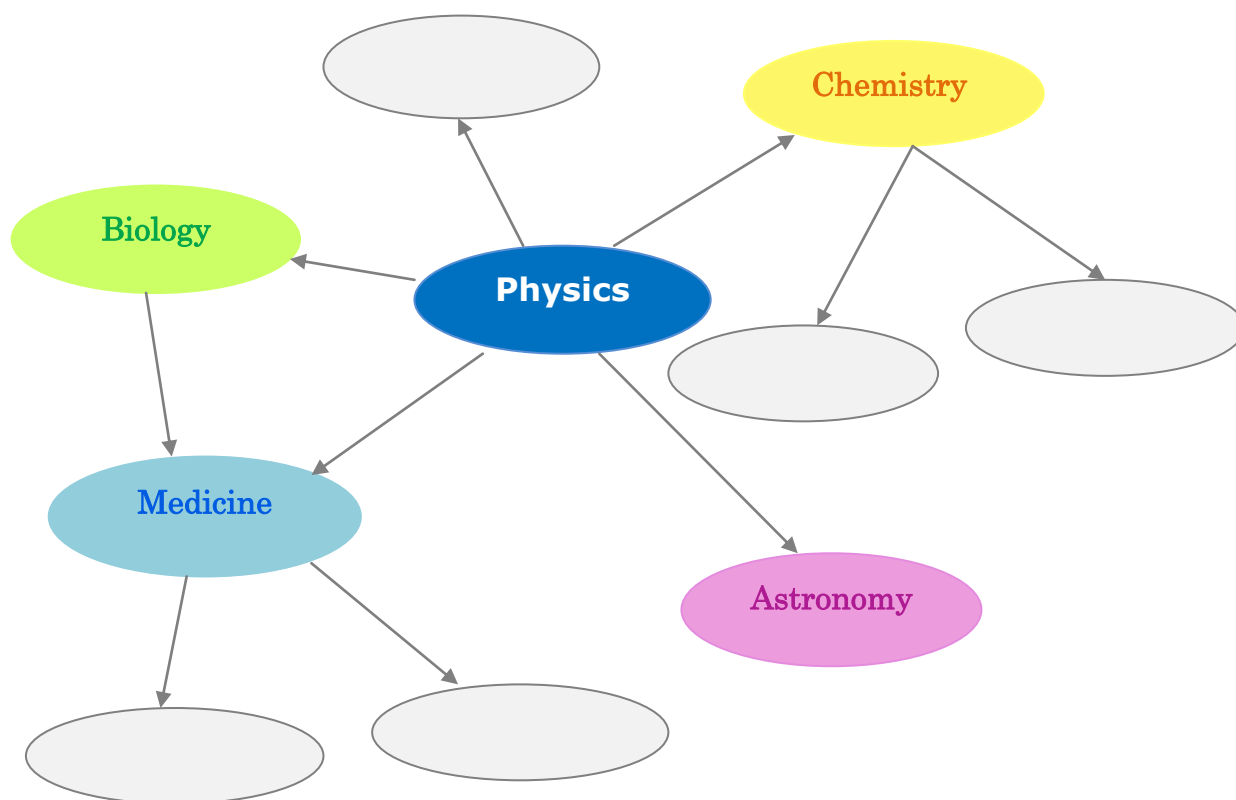
In this unit you will:

- ✓ learn new terms and general science words
- ✓ learn some idioms
- ✓ revisit different ways of expressing purpose
- ✓ use key words for efficient reading
- ✓ make a presentation on some interdisciplinary research in physics
- ✓ write a prospectus for an interdisciplinary department at your faculty

LEAD IN

1. Work in groups. Read the definition of 'Physics' and think how it is related to other sciences. Fill in the diagram and comment on how physics contributes to other fields of knowledge.

Physics ['fıziks] n – the science concerned with the study of matter and natural forces such as light, heat, movement, etc.

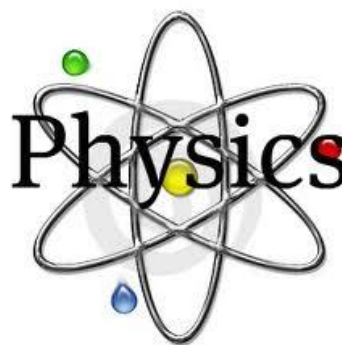


2. Are there any interdisciplinary departments (e.g. biophysics ...) at your faculty/university? What are they?
3. Would you like to specialize in any of these departments? Which one? Why?
4. Why is scientists' interest in interdisciplinary research increasingly growing worldwide? Is it true for your faculty?

READING

1. Match the headings (A-J) to the texts (1-9). There is one extra heading that you don't need to use.

- A. Fields in Medical Physics Education
- B. Photonic Technology Applied in Medicine
- C. Study of Our Planet's Properties
- D. Radio Nuclides Curing Diseases
- E. Physics Laws 'Rule' in Other Sciences
- F. Science Which Works Wonders
- G. Great Mission in Solving Global Problems
- H. Advances in Physics Leading to Breakthroughs in Medicine
- I. These Two Are Always Together
- J. Disciplines of Physics in the Study of the Universe



1) One trend in all fields of science over the past century has been to explore ways in which the five basic sciences (physics, chemistry, astronomy, biology, and earth sciences) are related to each other. This has led to another group of specialized sciences in which the laws of physics are used to interpret phenomena in other fields such as astrophysics, physical chemistry and chemical physics, geophysics, and biophysics.

2) Photonics is the technology of generating and harnessing light and other forms of radiant energy. Biophotonics uses photonic techniques across a range of biology based applications, including the therapeutic and diagnostic use of lasers in medicine and biomedical instrumentation.



3) When people think of the impact of science on medicine, they think of biology, they think of chemistry, they may even think of ecology. But they rarely think of physics.

Yet advances in fundamental physics have been responsible for many of the most important breakthroughs in medical science over the past half century. Think of magnetic resonance imaging, laser surgery, even chemotherapy. All of them have relied on dramatic breakthroughs in our knowledge of physics. Indeed medical physicists are responsible for the design and development of most high-tech equipment used for the diagnosis and treatment of a broad range of diseases, including cancer and cardiovascular and neurological disorders.

4) Atmospheric scientists study the Earth's air pressure, temperature, humidity, and wind velocity, and they apply physical and mathematical relationships to make short-range and long-range weather forecasts.

Physical meteorologists, for example, study the atmosphere's chemical and physical properties; the transmission of light, sound, and radio waves; and the transfer of energy in the atmosphere. They also study factors affecting the formation of clouds, rain, and snow; the dispersal of air pollutants over urban areas; and other weather phenomena, such as the mechanics of severe storms.



5) ICTP (International Centre for Theoretical Physics) recognized the relationship between physics and cutting-edge medical research and clinical applications several decades ago when it organized its first College of Medical Physics in 1983. Currently ICTP provides research and training for:

- *Diagnostic radiological physics* focusing on the use of x-rays, ultrasound, radiofrequency radiation and magnetic fields.
- *Radiotherapy physics* focusing on x-rays, gamma rays, electron particle beams and neutrons.
- *Nuclear medicine physics* focusing on the therapeutic and diagnostic applications of radio nuclides.
- *Medical health physics* focusing on x-rays, electron and other charged particle beams, and radio nuclides.

6) Astrophysics is the application of the theories and methods of physics to the study of stellar structure, stellar evolution, the origin of the solar system, and related problems of cosmology. Astrophysics is a broad subject, so astrophysicists typically apply many disciplines of physics, including mechanics, electromagnetism, statistical mechanics, thermodynamics, quantum mechanics, relativity, nuclear and particle physics, and atomic and molecular physics.

7) Only science, with physics as its foundation, can solve many of the serious crises facing our society, such as global warming, overpopulation, waning energy and other natural resources, and the poisoning of our planet. Our leaders need to consult scientists in their decision making.



8) A very typical definition of mathematical physics is the one given by the Journal of Mathematical Physics: "the application of mathematics to problems in physics and the development of mathematical methods suitable for such applications and for the formulation of physical theories."

This definition does, however, not cover the situation where results from physics are used to help prove facts in abstract mathematics which themselves have nothing particular to do with physics. This phenomenon has become increasingly important, with developments from string theory research breaking new ground in mathematics.

Eric Zaslow, professor of mathematics of North Western University, coined the phrase **physmatics** to describe these developments, although other people would consider them as part of mathematical physics proper.



9) To gain perspective into how much physics has contributed to our life, consider the following miracles from physicists: alternating current, hydroelectric power, electric motors, radio, microwave ovens, satellites, radar, modern rocketry, the solution of the DNA structure, nuclear magnetic resonance, magnetic resonance imaging, X-rays, lasers, transistors, light-emitting diodes, oscilloscopes, television, holography, and the World Wide Web (originally developed for high-energy physicists), among many others.

2. Make the right choice (a, b, c or d) to answer the questions and complete the sentences.

1) Which of the following sciences is not an interdisciplinary one?

- a) medical physics
- b) nuclear physics
- c) mathematical physics
- d) chemical physics

2) Photonics is the technology of generating and harnessing different forms of radiant energy which is widely used in

- a) laser surgery
- b) magnetic resonance imaging
- c) microwave equipment
- d) transistors

3) Which is not true? Physical meteorologists study

- a) the transfer of energy in the atmosphere.
- b) the atmosphere's chemical and physical properties.
- c) decreasing energy and other natural resources.
- d) the formation of clouds, rain and snow.

4) Eric Zaslow coined the phrase physmatics ...

- a) as a synonym to mathematical physics.
- b) to describe the application of mathematics to problems in physics.
- c) to describe developments in string theory.
- d) to describe the field of abstract mathematics which uses results of physics for proving some facts.

5) Which of the statements is false? Diagnostic radiological physics focuses on the use of for medical purposes.

- a) magnetic fields
- b) ultrasound
- c) x-rays
- d) thermodynamics

Study help

Answering multiple-choice questions

- Read the text(s) quickly to get the general idea of what it/they is/are about.
- Look at the first part of the question and underline the key words.
- Don't read options **a-d** yet. Find the part of the text the question refers to.
- Go through the choices and underline the key words.
- Choose the answer that fits best.
- Keep in mind that the information may be rephrased.
- Check your answer against the text.

Focus on language

1. Study the words in the box and classify them under the headings (1-3):

- 1) *Disciplinary science*: physics
- 2) *Interdisciplinary science*: astrophysics
- 3) *Disciplines of physics*: electromagnetism

physical meteorology	biophysics	chemistry
ecology	mathematics	particle physics
photonics	thermodynamics	mathematical physics
physical chemistry	quantum mechanics	astronomy
statistical mechanics	medicine	chemical physics

2. Look back in the texts (1-9) in *Reading* and pick up more words to add to the lists under each heading (1-3) in Task 1. Look them up in a dictionary for pronunciation and meaning.

Add new vocabulary to your vocabulary notebook. ✍

Get real

Search the Internet and/or popular science magazines to find out more about current interdisciplinary research projects involving physics in your country or worldwide. Choose the one you find most interesting and prepare a Power Point presentation about it. Use these questions as the guidelines:

- ✓ What is being investigated?
- ✓ Who is doing the research?
- ✓ How long has it been under way?
- ✓ What are the purpose and novelty of the research?

SPEAKING

Make your presentation in class and involve the rest of the group into discussion by encouraging them to ask questions.

Functional language

Dealing with questions

Could you repeat the question?/Well, the question is "...". Is that right?

I'll be dealing with that a little later on, so if you don't mind I'll answer this question then.

Does that answer your question?

I'm afraid I don't know the answer to your question. Perhaps someone here can help us out?

Focus on language

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

- The laws of physics are used **to** interpret phenomena in other fields.
- Medical physicists are responsible for the design and development of high-tech equipment used **for** the diagnosis and treatment of a broad range of diseases.
- Consider the following miracles from physicists **so that** you could gain perspective into how much physics has contributed to our life.
- What were your main reasons **for** joining this interdisciplinary project?
- ICTP organized its first College of Medical Physics in 1983 **in order to** provide research and training for diagnostic radiological physics, radiotherapy physics, nuclear medicine physics, and medical health physics.

2. Study the rules in the box and apply them for analyzing the sentences in Task 1 and Task 3.

Expressing purpose with	<i>to / not to / in order to / in order not to, so that and for</i>
1) to / not to in order to / in order not to	<ul style="list-style-type: none"> ▪ We use to/not to and in order to/ in order not to plus an infinitive when the main clause and the clause of purpose have the same subject. ▪ In order to/ in order not to is more formal than to/ not to.
2) so that	<ul style="list-style-type: none"> ▪ We can use so that when the main clause and the clause of purpose have the same subject or when the subject in each clause is different. ▪ We often use so that with can, could or other modal verbs and the main verb. ▪ We use so that when the purpose is <i>negative</i> (so that ... won't/wouldn't)
3) for	<ul style="list-style-type: none"> ▪ We use for with a noun or a gerund.

3. Match A with B to make sentences. Translate these sentences into Russian.

Example: In many cases physics is required to understand concepts in other sciences.

Во многих случаях требуется физика для понимания концепций в других науках.

A	B
1) In many cases physics is required	a) for understanding how musical instruments work.
2) Attend several classes and seminars in other departments	b) for translating complex verbal information into pictures and finally into mathematical models.
3) Physics is the science of sound and it is required	c) to understand concepts in other sciences.
4) Your lab report should be well-organized, clear and easy to read	d) to provide funding for doctoral students interested in interdisciplinary fields.
5) Physics requires students to use both right and left brain regions	e) so that I could achieve a good balance of research and teaching.
6) They should make employment opportunities more visible	f) in order to model proteins, identify particular things or people from among vast stores of video and images and to better understand the properties of superconductors.
7) Stanford University has recently created Interdisciplinary Graduate Fellowships programme	g) so that you could start socializing with colleagues in other fields.
8) I decided to apply for the position of a university lecturer	h) in order to convey information to the reader rather than puzzle them.
9) New hardware and quantum-computer applications are being developed	i) so that students in interdisciplinary programmes would have no doubts about their professional future.

4. In this unit you will come across several idioms. Read the definition of the word ‘idiom’ and match idioms in column A with their meaning in column B.

Idiom is a group of words established by usage as having a meaning not deducible from those of the individual words.

e.g. *to reinvent the wheel* = to waste a great deal of time or effort in creating sth that already exists = изобретать

велосипед

A	B
1) to break new ground	a) to be available or exist in a particular way
2) to come in a packet	b) decide that they belong to a particular class or category, often without considering all their qualities or characteristics
3) to think out of the box	c) to make use of an opportunity
4) to pigeon-hole someone or something	d) to know the basic facts or principles of that subject, especially as a result of a particular course of training or instruction
5) to take advantage of something	e) to think about sth, how to do sth, in a way that is new, different or shows imagination
6) to follow sb's path/to follow in one's footsteps	f) to do something innovative that is considered an advance or positive benefit
7) to have/maintain grounding in a subject	g) to go in the same direction as somebody

5. Match the idioms (1-7) in column A with their meaning in Russian (a-g).

- a) мыслить нестандартно, оригинально
- b) знать основы предмета
- c) навешивать ярлыки/вписывать в определенные рамки
- d) сказать новое слово/начать новую страницу/открыть новое поле деятельности
- e) идти по чьим-то стопам
- f) воспользоваться чем-либо
- g) иметь готовое решение

LISTENING

You will hear two people talking about their experience of interdisciplinary studies.

1. Listen to an interview with Paul Miller and complete the chart.

a) Name of the interdisciplinary programme (first subject area + second subject area)	
b) Advantages of doing interdisciplinary research	

c) Personal qualities of people who choose interdisciplinary study	
d) Job opportunities	
e) Advice for students who are thinking of enrolling in an interdisciplinary programme	

2. Listen again and fill in the gaps in the interview extracts.

I am pursuing my 1) _____ dissertation to develop an interdisciplinary graduate program in 2) _____ and management because I firmly believe that no 3) _____ is perfect and no real world problem comes in a 4) _____.

Working at the frontier of two fields rather than only one can be particularly 5) _____ but it provides the perfect training ground for thinking out of the 6) _____, developing the ability to make links between seemingly unrelated phenomena.

Besides success in interdisciplinary fields also requires the development of a common scientific

7) _____. Many of these graduates end up as consultants, contractors, entrepreneurs or writers – places where they don't have to be 8) _____. But I personally think that enrolment for interdisciplinary programs will increase only if employment 9) _____ become more visible.

3. Listen to an interview with Sue Stampe and answer the questions.

- What does Sue think of having training in an interdisciplinary field?
- What advantages and disadvantages of interdisciplinary studies does she discuss?
- What conclusion does she come to at the end of the talk?

4. Choose the correct word from the box to fill in the gaps in the interview extracts. There are two extra words in the box that you don't need to use.

supervisors	value	proper	opportunities	boundaries
limitations	polytechnic	versus	viability	primary plus

I have tenure* in a 1) _____ state university but it took me close to ten years to get my first tenure-track job. I would have made different choices had I known that would be the result of working across fields. I have taught in liberal arts colleges that 2) _____ breadth, but they typically do not provide any 3) _____ to continue an active research program.

Besides young scholars are often discouraged by their disciplinary 4) _____ from engaging in interdisciplinary research projects until they have first qualified for and obtained positions in their 5) _____ field. As a result it is much harder to find 6) _____ supervision in an interdisciplinary than in a disciplinary area.

The key point to learn from all this is to see your future not as disciplinary 7) _____ interdisciplinary, but rather as one of disciplinary and interdisciplinary. Maintain your grounding in your sub discipline while branching out across disciplinary 8) _____. Doing so will not only increase the 9) _____ of your research career; it will make it much more interesting.

* tenure - бессрочный контракт - If you have tenure in your job, you have the right to keep it until you retire.

5. Listen to the interview again and check if you have completed the sentences correctly.



"I'M ON THE VERGE OF A MAJOR BREAKTHROUGH, BUT I'M ALSO AT THAT POINT WHERE CHEMISTRY LEAVES OFF AND PHYSICS BEGINS, SO I'LL HAVE TO DROP THE WHOLE THING."

Discuss

In a small group discuss these issues and share your ideas with the class.

- The first speaker in the listening task says:
"No discipline is perfect and no real world problem comes in a packet that's why interdisciplinary education and research seem to be inevitable."
Do you agree with this statement?
Give your reasons.
- The second speaker says that it is much harder to find proper supervision in an interdisciplinary field than in a disciplinary area.

Is it true for your faculty/university?

- Are employment opportunities as good in interdisciplinary areas as in disciplinary fields in your country?
- How do you understand the message of the picture? Comment on it.

READING

Read the text about some advantages of interdisciplinary research.

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

- a) Discipline-based research dominated in science for years but nowadays it has lost its mainstream position. ()
- b) Only discipline-based approach results in outstanding advances in science. ()
- c) Nowadays the integration of information, techniques, concepts and theories from several disciplines contributes to better understanding of many challenging problems. ()
- d) The field of 'smart' materials and structures is good evidence of successful collaboration among researchers with backgrounds in different sciences. ()
- e) Interdisciplinary research projects are not popular world-wide because they require huge financial and intellectual resources. ()

Realizing Benefits from Interdisciplinary Research

For much of the last century the route to success for most scientists involved identifying a subfield within a discipline and then becoming an expert in it. For many scientists this approach still works. Discipline - based research continues to provide the core of our knowledge about the universe and has led to many fundamental breakthroughs in science.

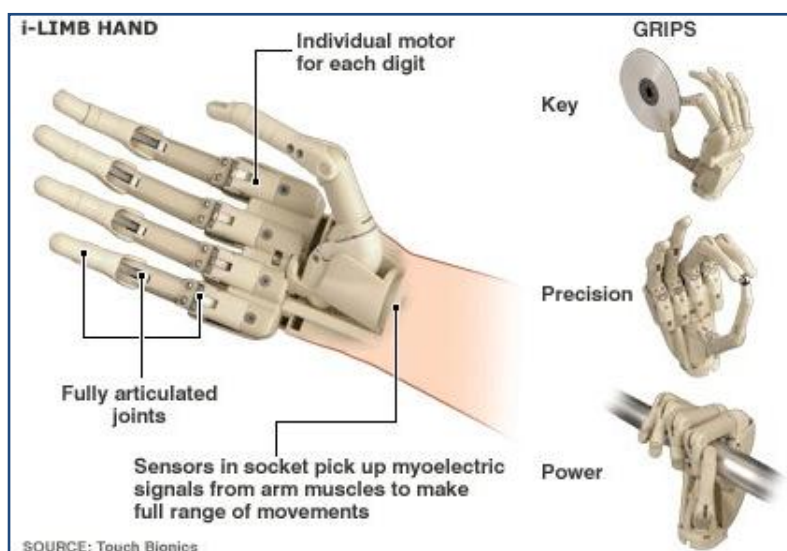
But today, many of the exciting problems in science are too complex to yield only to a discipline - based approach. They require the contributions of scientists from a number of different fields, each bringing their expertise into interdisciplinary research.

Interdisciplinary research is a mode of research by teams or individuals that integrates information, data, techniques, tools, concepts, and theories from two or more disciplines to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or field of research.

The Interdisciplinary Physics is the application of methods and tools of physics to other fields of research, namely biology, chemistry, mathematics, astronomy, geology, economics, sociology and others. An example is the current exploration of string theory by theoretical physicists and mathematicians, in which the questions posed, have given fundamental new insights both to mathematicians and to physicists.

Besides consider the field of "smart" or "intelligent" materials and structures. Here, investigators with backgrounds in physics, chemistry, materials science, biology, mathematics, computers, and engineering cooperate in developing human-made artifacts which sense and respond to their environment by learning, adapting, and repairing themselves.

One great advantage of interdisciplinary science is that it allows people in different fields to work together towards a common objective. Multidisciplinary programs are now under way at many research institutions across the world. At Stanford University alone there are over 22 interdisciplinary research centers, including the recently established BioX program. This \$210-million project combines the work of investigators from physics, chemistry, biology, engineering, and medicine in such areas as tissue engineering; single molecule analysis and molecular structure; cognitive and systems neurosciences; imaging from molecules to humans; and biocomputation. With the growth of the Web, many interdisciplinary programs have gone global, making them both cross-cultural and cross-disciplinary.



Summarizing

1. Read the text “На стыке наук” and highlight the Russian equivalents to the English word combinations (1-11).

- 1) complex and diverse
- 2) to study/understand sth in terms of chemistry/physics
- 3) high-quality breakthroughs
- 4) new sciences are emerging
- 5) at the frontier of traditional disciplines
- 6) to describe some class of material systems
- 7) to be regulated by the laws of physics
- 8) to be determined by physical properties of atoms and molecules
- 9) to be closely connected with sth
- 10) mathematical expressions
- 11) a united science of the future

Add new vocabulary to your vocabulary notebook. ✍

На стыке наук

Окружающий нас мир сложен и многогранен. Познать его невозможно с позиций только химии, только физики, только биологии и т.д. Качественные прорывы в решении проблем науки возможны при использовании знаний и методов многих традиционных дисциплин. Так возникают всё новые и новые науки на «стыке» традиционных дисциплин.

Физику иногда называют «фундаментальной наукой», поскольку другие естественные науки (биология, геология, химия и др.) описывают только некоторый класс материальных систем, подчиняющихся законам физики. Например, химия изучает молекулы и образованные из них вещества. Химические же свойства вещества определяются физическими свойствами атомов и молекул, описываемыми в таких разделах физики, как термодинамика, электромагнетизм и квантовая физика.

$$\begin{aligned} E_z(x, y, z) &= \frac{z\sigma}{2\epsilon_0} \int_0^\infty \frac{R dR}{(R^2 + z^2)^{\frac{3}{2}}} \\ &= \frac{z\sigma}{2\epsilon_0} \lim_{a \rightarrow \infty} \int_0^a \frac{R dR}{(R^2 + z^2)^{\frac{3}{2}}} \\ &= \frac{z\sigma}{2\epsilon_0} \lim_{a \rightarrow \infty} \left[-\frac{1}{\sqrt{R^2 + z^2}} \right]_0^a \\ &= \frac{z\sigma}{2\epsilon_0} \lim_{a \rightarrow \infty} \left(\frac{1}{\sqrt{z^2}} - \frac{1}{\sqrt{a^2 + z^2}} \right) \\ &= \frac{z\sigma}{2\epsilon_0} \frac{1}{|z|} \\ &= \frac{1}{2\epsilon_0} \sigma \frac{z}{|z|} \end{aligned}$$

Физика тесно связана с математикой: математика предоставляет аппарат, с помощью которого физические законы могут быть точно сформулированы. Физические теории почти всегда формулируются в виде математических выражений, причём используются более сложные разделы математики, чем обычно в других науках. И наоборот, развитие многих областей математики стимулировалось потребностями физических теорий.

Один из важных путей взаимодействия наук - взаимобмен методами и приемами исследования, т.е. применение методов одних наук в других.

Многие специалисты считают, что наиболее быстрого роста и важных открытий сейчас следует ожидать как раз на участках "стыка", взаимопроникновения наук и взаимного обогащения их методами и приемами исследования. Этот процесс объединения усилий различных наук для решения важных практических задач получает все большее развитие и способствует формированию «единой науки будущего».

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

Get real

Search the Internet site and/or prospectus of your university. Collect information about several interdisciplinary departments at your faculty/university. Choose the one that is most interesting for you and find information about:

- ✓ the date of its foundation and the leading researchers
- ✓ the major areas of current research, scientific objectives and accomplishments
- ✓ the facilities of the department (laboratories, equipment, research schools and traditions, etc.)

SPEAKING

Present your findings to the class. Follow the guidelines in the *Study help* box.

Study help

Structure of a presentation

Introduction (takes 10% of the time)

- Greet the audience and introduce yourself
- Introduce the subject of your presentation, give purpose and main points
- Try to capture interest (by asking a question, giving some quotation or surprising fact)

Main part (takes 80% of the time)

- Have 3 or 4 main points (not more)
- Have signposts and summaries
- Give examples

Conclusion (takes 10% of the time)

- Summarize what you've said
- Thank for attention
- Invite questions

Project Work

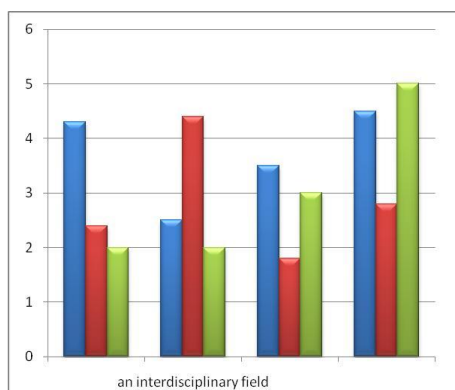
Work in groups of four.

1. Analyse the information about several interdisciplinary departments presented by your fellow students in the Speaking task. Summarize this information as a one-page poster.

Functional language

Presenting somebody's opinion

It surprised us to learn that most students/professors, etc...
The majority of students/people/interviewees think that ...
A few students/of my friends have got mixed feelings about...
A number of students/people/interviewees are in favour of ...
What we find really astonishing (about) ... is ..., etc.



2. Using your group poster conduct a survey to find out which interdisciplinary fields attract your respondents most. (Decide which group you will interview – undergraduate, graduate or postgraduate students or your university teachers). Note down the reasons they give in favour of a particular field and the most interesting comments.
3. Analyze your findings and make a bar chart like the one in Task 2 reflecting your survey results. Present this information to the class using the phrases from the *Functional language* box.

Write a group report on the results of your survey. Make use of the Survey Report Form.

Study help *A survey report*

To write a survey report, follow these steps:

1. Outline the purpose of performing your survey - detail why this survey was developed, who developed this survey and what outcome you expected.
2. Define how the survey was performed - fully describe how you chose your survey takers, questions asked and any other relevant information.
3. Gather your statistical information and organize this into a table, bar chart or graph that can be visually understood by the reader.
4. Write a conclusion that sums up your findings.

A survey:

Introduction & Objective

.....
.....

Survey Respondents

.....
.....

Questions & Findings

.....
.....
.....

Conclusions

.....
.....
.....

Visual representation of the statistical data
(a table/bar chart/graph)

Name

Date

In the Realm of Science

The words in the table can be useful when you speak about interdisciplinary sciences and research. Find their proper equivalents in your language.

Discipline	is an area of knowledge or field of study that is taught and researched at the college or university level.
Disciplinary	refers to knowledge associated with one academic discipline or profession.
Multidisciplinary	refers to knowledge associated with the mixture of academic disciplines in that each discipline retains its methodologies and assumptions without change or development from other disciplines.
Interdisciplinary	refers to new knowledge or one single discipline which resulted from combining two or more academic fields. An interdisciplinary field crosses traditional boundaries between academic disciplines as new needs and professions have emerged.
Transdisciplinary	refers to a research strategy that crosses many disciplinary boundaries to create a holistic approach. It applies to research efforts focused on problems that cross the boundaries of two or more disciplines, such as research on effective information systems for biomedical research (see bioinformatics), and can refer to concepts or methods that were originally developed by one discipline, but are now used by several others, such as ethnography, a field research method originally developed in anthropology but now widely used by other disciplines.
Crossdisciplinary	refers to knowledge that explains aspects of one discipline in terms of another. Common examples of crossdisciplinary approaches are studies of the physics of music or the politics of literature.

Progress Monitoring

In this unit you have worked on the vocabulary on the topic: “Interdisciplinary Physics”.

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

- | | |
|--|---|
| 1. to interpret phenomena in other fields of science | 11. to have nothing to do with |
| 2. design and development of high-tech equipment | 12. to break new ground in sth |
| 3. therapeutic and diagnostic use of sth | 13. to become increasingly important |
| 4. advances in fundamental physics | 14. to come in a packet |
| 5. to be responsible for sth | 15. to prove relevance to practice |
| 6. to work together towards a common objective | 16. to think out of the box |
| 7. to make short-range and long-range forecasts | 17. to give new insights to sb |
| 8. to recognize the relationship between physics and cutting-edge medical research | 18. to rely on dramatic breakthroughs in our knowledge of physics |
| 9. to provide research and training for sth | 19. to be under way |
| 10. formulation of physical theories | 20. to be at the frontier of several disciplines |

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

- a) advances, approaches, breakthroughs, insights
- b) scientist, supervisor, scholar, researcher
- c) ecology, thermodynamics, electromagnetism, relativity
- d) cutting-edge, diagnostic, therapeutic, clinical
- e) to integrate, to work together, to explore, to cooperate
- f) equipment, tool, artefact, device

2. Give English equivalents to these Russian word combinations.

- a) терапевтическое и диагностическое использование лазеров
- b) становиться всё более важным
- c) мыслить оригинально/не думать шаблонами
- d) делать краткосрочные и долгосрочные прогнозы
- e) работать совместно для общей цели
- f) на стыке нескольких дисциплин
- g) не иметь никакого отношения к чему-либо/кому-либо

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

e.g. [ˌɪntəˌdɪsɪplɪˈn(ə)rɪ] – interdisciplinary – междисциплинарный

- a) [ˈʌltrəsaʊnd]
- b) [hjuːˈmɪdətɪ]
- c) [vɪˈlɒsɪtɪ]
- d) [frʌnˈtɪə]
- e) [ˈnjuːtrən]
- f) [mægˈnetɪk ˈrezənəns ˈɪmɪdʒɪŋ]
- g) [ˈsuːpəvaɪzə]

4. Put two sentences together to make up a sentence of purpose.

Use *to / in order to / for doing something / so that*.

*Example: My friend chose the Physics Department. He had several reasons for that.
My friend had several reasons **for choosing** the Physics Department.*

- a) Two Research Institutes signed the collaboration contract. Now scientists in different fields can work together towards a common objective.
- b) I wanted to get the top grade at the exam in Mathematical Physics. I had to work hard.
- c) At my department lab classes are widely used. In these classes we practise the application of physical laws and logic to real cases.
- d) Before you come to the laboratory, study carefully the laboratory manual. You can plan in advance how to use your time effectively.
- e) In the lab follow all written and verbal instructions carefully. In this way you will avoid all possible accidents.
- f) Galileo pioneered the use of experimentation. It helped him to validate physical theories.