EXTRATERRESTRIAL MAPPING AS A BASE FOR EXTRATERRESTRIAL GEOGRAPHY

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Until recently it regards, that the study of territories locating outside the Earth, is the subject of astronomy. In fact, astronomers did not discuss these territories, their surfaces. they had interest in celestial body as an object, as a whole, and they also interested in its motion, rotation, distribution in space etc.

On a threshold of the third millenium it is expediently to represent " GEOGRAPHY of EXTRATERRESTRIAL TERRITORIES " as an independent subject within the framework of a facultative course. For 40 years of space research the huge material and information volume was accumulated. The Solar System bodies were described in the most various aspects from the point of view of their shells study.

The facultative course is offered to give a title " **Geography** of Extraterrestrial Territories", because such concepts (geophysics of planets, geology of planets, geochemistry of planets etc.) are widely used in practice of the planetary nomenclature. The latter is explained by fact that the data of these fields are investigated and stated from view of the people living on the Earth, instead of "population" of considered celestial bodies.

On the basis of this course pupils must begin to study outcomes of Deep Space investigations. The main purpose is to prepare the human community to acceptance of optimal solutions connected to the further assimilation of Deep Space. Knowledge on fundamental scientific problems of Solar system origin and evolution, origin of life, of course, is very important. At the same time problems of mankind cooperation on the peaceful basis seems not less important for space assimilation. The last one, in turn, conducts to decrease of confrontation level in society, progress of engineering and development of the newest technologies required for implementation of space projects and, at last, to use of these achievements in daily life.

The program of new course leans on the following principles:

1. Necessity of explanation to the pupils the methods and means of space research as the sources of the information about the nature of Solar system bodies on level accessible for them.
2. Problematic character and variety of space research,
3. Orientation of the pupils to life under conditions of an informatics society, optimization of the content of course on the base of using the information systems,

using the Internet, and other capabilities connected to application hereafter of computer facilities.

The course content is built taking into account the principles listed above.

First of all, it is necessary to avoid repetitions, precisely being guided on that level of geographical preparation, which is already incorporated by the previous courses. Further it is offered sequentially to use already being available knowledge and approaches, but with allowing of specifity of particular celestial bodies.

Main feature of the offered course is an attempt to approach to us the Solar system bodies, to look at them from point of view of a geographer (not an astronomer or an astronaut), to deliver them in a number of objects investigated by geography, namely geography of oceans and continents, economic geography, at last, geography of extraterrestrial territories.

At the beginning of space research it has already become obvious, that, by studying other celestial bodies, we shall try to transfer our earth experience on them. Thus it is necessary to use the earth nomenclature, i.e. to speak about geology, geophysics, geography, geodesy, geochemistry of celestial bodies. Attempts to enter into custom such a subjects as selenology or selenography for the Moon, areography for Mars etc. were stopped very soon.

The other, not less important feature of course is an application of a comparative planetology approach by presenting the material. All the problems connected to the structure of celestial bodies and structure of atmospheres, climate, with processes of relief origin and models of an inner structure are stated taking into account the achievements of comparative planetology.

Besides the assimilation of extraterrestrial territories is considered from the point of view of main road for the people living on the Earth. It is made for the first time in course of geography. The perspectives of using this process by the solution of global problems facing to mankind (ecological, demographic, food, power, raw material) are discussed in this connection.

The special attention is given to necessity of all human community cooperation for solving problems connected to assimilation of extraterrestrial territories and, as a result, refusal from confrontation and disarmament.

The historical approach is incorporated in the program with the humanism purpose of the course content. The history is exhibited in consideration of changes and oscillations of natural processes happening on the celestial bodies. It is also made by demonstration of historical development influence on modern economy and policy in a sphere of assimilation of extraterrestrial territories, including role of this process (assimilation) in

the solution of global problems of mankind, namely peace cooperation in space, ecological, demographic and other problems.

The practical tasks, adduced in the program, are mainly oriented on activity with the textbook, small-scale general maps, maps of regions and maps on local sites of a surface, Atlas of Terrestrial Planets and Their Moons, and also on contour and thematic maps. The separate tasks require additional sources of information which have been not intended specially for school. They can be designed if there is necessary maintenance. The organization of educational activity of the pupils in these cases depends on duplicating of fragments of non-traditional sources of the geographical information with the help of local multiply engineering.

It is supposed, that during this course (during the year) each pupil will execute one from creative activities, offered in the program, (on selection).

In the course program should be allotted approximately 20% content to a practical component, during activity on the program the teacher can orient the pupils and their parents on an eventual result of training to the given course.

The course is naturally included in the special program on geography of extraterrestrial territories, which contains

1.Testing of pupils for their level of knowledge,

2.Development of methodical materials for the teachers,

3. Writing the text-book " Geography of Extraterrestrial Territories " under the facultative program (for 8-9grades),

4. Writing the text-books " Comparative Planetology " and " Planetary Cartography" under the profile program (for 10-11grades),

5. Development and issue of the manuals, including series small-scale general geographic maps for some celestial bodies, series of contour and thematic maps.

THE PROGRAM of FACULTATIVE COURSE " GEOGRAPHY of EXTRATERRESTRIAL TERRITORIES " (34 h)

INTRODUCTION. (1h)

Extraterrestrial territories assimilation. Goals and problems. Approaching them to the Earth. Means of assimilation. Perspectives of Mars assimilation. The Moon as laboratory for experiments. An urgency of assimilation. The danger of asteroids.

THEME 1. (3 h) ASSIMILATION of EXTRATERRESTRIAL TERRITORIES and GLOBAL PROBLEMS of MANKIND

Ideas of K.E.Tsiolkovsky: an output from the Earth, flights to other celestial bodies, colonization of the Solar system as a main road of mankind development. International cooperation as a necessary premise of Space assimilation. Association of efforts of all

human community for solving problems connected to assimilation of extraterrestrial territories and, as a result, refusal from confrontation, disarmament.
Paths of the solution of ecological, demographic, food, power and raw material problems by means of creation of new environment (out of the Earth). Wide use of Space as platforms for observations, as sensor of the information about the Universe, as polygon for research and experiments.
Definition of concept " extraterrestrial territories ". Their classification (planet of earth group, their moons, moons of giant-planets, asteroids). An adopted system of names. Legal aspect of extraterrestrial territories assimilation. A problem of immunity (non-appropriation) of extraterrestrial territories.

THEME 2 (6 h) EXTRATERRESTRIAL TERRITORIES and FEATURES CONNECTED to THEIR STUDY.

Formation of a planetary system out of a protoplanetary cloud. Its age. Hypothesises of an origin and evolution of Solar system bodies. Differentiation of substance. The theories of formation of planet moons. "Acquisition"of asteroids. Separation of affiliated bodies from a basic body. Simultaneous formation of the Earth and the Moon. Their age.

Ground observations. Their evolution. Stages of observations: visual, telescopic visual, telescopic photographic in optical band, in other bands. Changes in understanding of Solar system bodies. Drawing up of the first maps. Introduction of geographical names. Earth mountains on the Moon. The coordinate grid. The catalogues of control points.

Modern sources of knowledge. The information obtained from space vehicles and spacecrafts. Flyby of planets, their moons, asteroids, comets. A fly-around of the Moon with return to the Earth. Study of the Moon, Venus, Mars, Jupiter from orbits of artificial satellites. The information from vehicles descending to the surface of the Moon, Mars, Venus. Data transfer after landing to the surface of the Moon, Mars and Venus. Means of transport, controlled from the Earth, on the Moon and Mars. Atmospheric probes on Venus and Mars.

Simulation of celestial bodies processes on the Earth. Main shells of planets. Their features. The theory of shells definitition: atmosphere, hydrosphere, litosphere (crust, mantle, nucleus). Near-the-planet (planet environment) Space.
Comparison to the Earth. A sight from a comparative planetology point of view.

THEME 3 (8 h) ATMOSPHERE of SOLAR SYSTEM BODIES

Atmospheres of the Earth group planets. Atmosphere, directed by a solar wind, to Mercury. A chemical structure of Venus and Mars atmospheres. Models of the structures of their atmospheres. Main parameters of their atmospheres (temperature, pressure, humidity). Conditions on the surface. Circulation of atmospheres. The

hothouse effect in Venus atmosphere. Weather conditions. White clouds, fogs, hazes and polar mist on Mars. Dust storms on Mars. Lightning on Venus. Climatic features in a comparison with the Earth. Seasons on Mars and on the Earth. Evaluation of climatic conditions. Influence them on the human being.

Atmospheres of giant-planets. Their chemical structure and models. Thunder-storms on Jupiter.

Practical activities. 1. To make the aggregate table of a chemical structure of atmospheres of separate celestial bodies in comparison with the Earth. 2. To represent graphically models of atmospheres for Venus, Mars and the Earth. 3. To make the aggregate table describing conditions at the surface of Venus, Mars and the Earth.. 4. To evaluate climatic conditions on planets of the Earth group and their influence on human being.

THEME 4 (7ч) SURFACE RELIEF of SOLAR SYSTEM BODIES

Major factors for relief origin.Volcanism. Meteoritic bombardment. The special role of wind processes on Venus and Mars. Tectonic and tidal Moonquakes. Micrometeoritic bombardment on the Moon. Specifity of surface processes on the Moon, Venus and Mars. Similarity to the Earth and difference to it.

Macro -, мezo- and microrelief. Asymmetry of the macrorelief forms. Specific relief features. Large rupes of Mercury. Caloris Plain on a Mercury. "Parquet" on Venus. The specific relief forms of Venus: tesseras, coronas, ovoids etc. Ray systems and catenae of craters on the Moon. Large extinct volcanoes on Mars. Chaoses and labyrinth on Mars. A riddle of a system of Mariner canyons. A system of Phobos fossae. Albedo anomalies of Deimos craters.

Features of relief of giant-planets moons and asteroids. The active volcanoes of Jupiter moon Jo.

Features of construction of the relative age scale of the relief forms.

Relief of celestial bodies as environment for the human being.

Practical activity: 1. Macrorelief of Mercury, the Moon, Venus, Mars, Galilean moons of Jupiter: to select on contour maps continent and marine plains, largest craters on the Moon, extended rupes and Caloris plain on Mercury, chaoces and labyrinth on Mars, large volcanoes and the large system of Mariner canyons on Mars, tesseras, coronas and ovoids on Venus 2. To describe macrorelief of the Earth group planets in a comparison with the Earth. 3. To construct of relative age scale of relief forms for the Moon.

THEME 5 (3h) INNER STRUCTURE of SOLAR SYSTEM BODIES

Element structure of surface rocks. The prognosis of mineral availability on the Moon and Mars. Rock composing crust. Similarity to the Earth and difference to it. Seismic activity of the Moon. Gravitational fields of the Moon, Mars, Venus. Gravitational anomalies on the Moon. Mascons and masmins as positive and negative gravitational anomalies. Paleomagnetism on the Moon.

Models of the inner structure of the Moon, Mercury, Venus, Mars, the Earth. Similarity and differences.
Models of inner structures of Jupiter, Saturn, Uranus, Neptune. Their specifity.

Practical activity: 1. To make a table of surface rock element structure of the Moon, Mars and the Earth 2. To make a map of seismic activity of the Moon. 3. To compare models of an inner structure of giant-planets.

THEME 6 (7h) PERSPECTIVE of SPACE ASSIMILATION

The programs, projects, prognosis. Permanent operational base on the Moon. Water production on the Moon. Manned flight to Mars. Colonization of Mars. Increase of mean temperature up to 0^0. Increase of atmosphere density. O'Nail settlements in libration points.
Production of mineral raw material on asteroids. Creation of a biosphere on Mars and Venus. Change of the human being as biokind.

Practical activities: 1. Model building of permanent operational lunar base. 2. Development of the project for Mars population . 3. Drawing up of a list of optimum conditions for assimilation of extraterrestrial territories by the people.

THE CONCLUSION (2h)

Geography of extraterrestrial territories and comparative planetology. The Earth in a comparison with other Solar system bodies. Origin and evolution.
Formation of atmosphere, hydrosphere,lytosphere. Natural resources. Processes connected to assimilation. Ecological problems. The asteroid danger.

It was at the beginning of the nineties when we began to discuss and later to develop a conception of extraterrestrial geography. Planetary maps and globes should play very important role in it. The main idea was that it is necessary to prepare the mankind in the whole to space explorations in future, to manned mission to Mars, to permanent base on the Moon and to make right decisions in this field. On the one side, today there are a lot of Mars, Moon, Venus maps in various small and large scales (at one sheet and at many sheets using different classes of projections), maps of some giant-planet moons and asteroids, maps of comets. On the other side this information is concentrated in special laboratories and scientific institutes, in very limited number of countries. But we consider that this knowledge must be accessible for the whole mankind, especially for the young generation. That is why it is a good time to begin with such education at school. On the threshold of the new Millenium the educated people must hear about chaoces on Mars, tesseras on Venus, catenas on the Moon and so on. Special program on extraterrestrial geography is created We consider it as a base for the course of extraterrestrial geography for school and began to work with it. This program includes parallel to pupils testing, special materials for teachers, writing text-books on extraterrestrial geography for 8-9 grades, on comparative planetology and planetary cartography for 10-11 grades (as profile subjects) also compiling various help material for exercises, viz. contour and thematic planetary maps, globes etc. Today it is possible to tell children about atmosphere and climate on the planets, about relief and morphology of their surface, about inner structure using thematic maps and topographic plans and diagrams. We also suppose that the multilingual map series belongs to the first steps on this way.