

UDC 531.35

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ICT IN THE LESSONS OF ASTRONOMY

Annotation. *The article presents an overview of computer programs that contribute to a better assimilation of the subject of astronomy in high school. Particular attention in the article was paid to the components of the World Wide Telescope and Stellarium virtual telescopes, which make it possible to simulate various astronomical processes in real time.*

Keywords: *Stellarium, World Wide Telescope, virtual telescopes, ICT in astronomy lessons, astronomy teaching methodology*

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Аннотация. *В статье представлен обзор компьютерных программ, способствующих лучшему усвоению предмета астрономии в рамках средней школы. Особое внимание в статье было уделено компонентам виртуальных телескопов «World Wide Telescope» и «Stellarium», позволяющих моделировать разнообразные астрономические процессы в режиме реального времени.*

Ключевые слова: *Stellarium, World Wide Telescope, виртуальные телескопы, ИКТ на уроках астрономии, методика преподавания астрономии*

The astronomy program includes students' acquaintance with virtual telescopes. Such work can not only replace the student's moving map of the starry sky, but also expand the possibilities for making observations using

telescopes or without them. Applications can also be installed on all existing mobile platforms, in addition to computers.

To simulate the operation of optical telescopes, the teacher can use any available software. The advantage of modern virtual telescopes is not only the use of graphics and databases of astronomical objects, but also the construction of images of objects from real photographs taken at different times on Earth and beyond. Consider the example of the virtual telescope "World Wide Telescope".

WORLD WIDE TELESCOPE (WWT) is a computer planetarium that allows you to study a detailed photographic map of the starry sky, view the surface topography of many bodies in the solar system, and travel around the Earth and the Universe. The photographs are taken from 10 terrestrial telescopes and the Hubble Space Telescope. To create a photographic map, materials from Roscosmos and the US Geological Survey were used. The WWT virtual telescope allows you to study astronomical phenomena at any time from 1 to 4000 AD. WWT includes several modes of operation:

The Earth mode provides users with the ability to view a detailed map of the Earth's surface.

Planet mode provides users with the ability to view detailed images of the Moon, the closest planets to Earth (Venus, Mars, Jupiter) and the Galilean satellites.

The "Sky" mode will include a Terapixel stellar panorama based on images taken by various telescopes in a variety of ranges - from radio waves to gamma rays. The high quality of the panorama allows it to be scaled in a real planetarium.

Panorama mode allows the user to view panoramas of the surface of the Moon and Mars.

The "Solar System" mode offers the user to study a three-meter model of the part of the Metagalaxy known to us.

Another noteworthy program for working with the starry sky is, of course, the Stellarium virtual telescope..

STELLARIUM is a free planetarium program that allows you to see objects accessible by medium and large telescopes. It also allows you to observe solar eclipses and the movement of small bodies in the solar system.

- ✓ Let's pay attention to some features of the Stellarium program.
- ✓ On the star map you can show:
- ✓ more than 120,000 stars of the Hipparcos catalog;
- ✓ planets of the solar system and their satellites;
- ✓ asterisms and images of constellations in different cultures;
- ✓ images of Messier catalog objects;
- ✓ a realistic picture of our Milky Way Galaxy;
- ✓ realistic landscapes on the Earth's surface.

The program interface includes:

- ✓ standard, wide-angle and spherical design methods;
- ✓ the ability to scale the image;
- ✓ time scale management with the ability to write your own scripts;
- ✓ control of the virtual telescope.

Visualization includes:

- ✓ choice of projections;
- ✓ choice of grid of the celestial sphere;
- ✓ selection of the landscape of the observation site and its disabling;
- ✓ taking into account the effect of refraction and extinction;
- ✓ accounting for historical outbursts of supernovae and new stars;
- ✓ changes in the shape of the constellations over time.

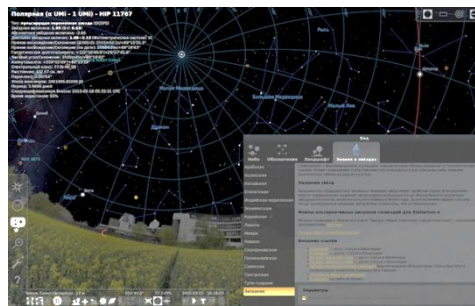
As an example, the teacher might look at the user's steps to determine the viewing conditions for the M31 nebula in the constellation Andromeda. A similar problem can be solved for any place and time of observation. Just such a

task, oriented to the conditions of observation in a given area, should be initially solved in the lesson



Ris. 1. Screenshot of the Stellarium program website

Schoolchildren can get acquainted with the Stellarium program using educational tablets, a mobile computer class, or just a class of desktop computers. For extracurricular activities, you can advise students to install the program on a computer at home.



Ris. 2. Screenshot of the Stellarium program window

The Stellarium Virtual Telescope also allows students to explore celestial objects such as exoplanets and deep space objects.

As an additional source of information on astronomy, students can use popular encyclopedias with a planetarium function, for example, the RedShift program.

The considered software tools make it possible to diversify the lessons of astronomy, which is very important, since the subject of astronomy, regardless of the chosen profile, is studied by students at a basic level. This means that astronomy at school should be considered primarily as a general cultural and philosophical subject.

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