Enclosure 1
Scenario of introductory lesson

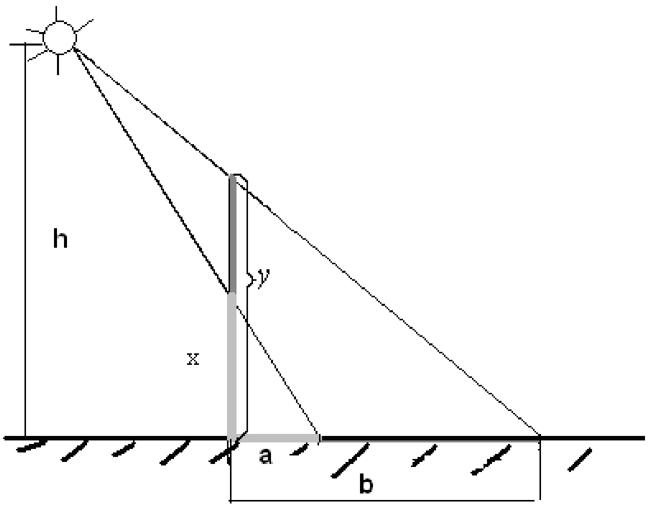
Theme: Astronomical table of Nicolaus Copernicus

General aim: Get to know the scientific gnomon-reflection method employed by Nicolaus Copernicus.
Operational aims: Student:

- knows the properties of light, particularly rectilinear transmission of light and law of light reflection,
- understand the action and the role of mirror,
- knows what it is and for what serve gnomon,
- knows how shadow emerges and what are the factors which have influence on its lenght,
- knows - how to take advantage of equinox phenomenon for real research of movement of Earth around Sun.

Educational tools:
Instruments for demonstration: a piece of paper, laser, mirror, board, sheet of paper to list of students willing to experiment.
Methods: experiments, a talk, discussion.
Forms: collective, individual

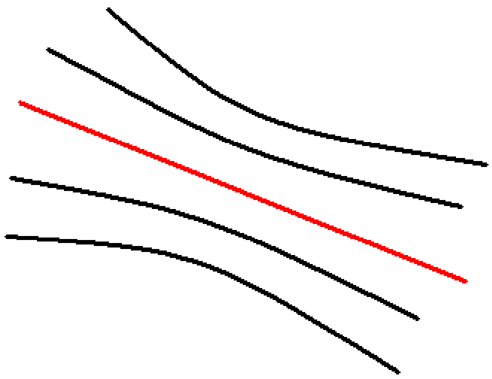
Teacher's activities	Student's activities
1. Introduction	
Organisation of lesson: welcome, checking of presence	
Communication of theme of the lesson	Writting the theme of the lesson: „Astronomical table of Nicolaus Copernicus".
Question 1: Who was Nicolaus Copernicus? **Question 2**: At the rurn of which centuries He lived?	**Answer:** Polish astronomer, physician, and a canon and lawyer, who, referring to some ideas from antiquity proposed and described the heliocentric system of the Universe. **Answer:** At the turn of the fifteenth and sixteenth century (1473 – 1543r.).
2. Explication of lesson	
I. History of astronomical table discovery	
Question 3.: Have you ever heard something about the astronomical table of Nicolaus Copernicus?	**Answer**: No.
It is located at the Castle in Olsztyn. In 1802, John Sniadecki in his work "On Copernicus" on the basis of the report of Tadeusz Czacki and Marcin Molski from the Warsaw Society describes the residence of Nicholas Copernicus University in Olsztyn, and also the memorial left at by him the castle –astronomical table. He specified that it was created by the use of gnomon-reflection method . It was a time when Poland was under foreign rule, and looked for signs of Polish in various locations throughout the Republic at that time.	
I. Astronomical gnomon	
Question 4: What is gnomon ?	**Answer:** It's vertical, in relation to the plane rod -bar, whose shadow indicates the height of the Sun above the horizon, often called the simplest sundial.
Gnomon utilizes the phenomenon of rectilinear propagation of light, so the shadow of the rod is a straight line, whose length depends on the height of the pillar and the height of the source	Students write a short note:. Eg. 1. Gnomon - in relation to the plane vertical rod -bar, whose shadow indicates the

of light. For example, if the at the sidewalk on a sunny day my dad comes with a small son - dad's shadow is longer than the shadow of the child because an adult is higher. It is illustrated by the rawing on the blackboard:  x – height of child,, y – height of dad,, h – height of Sun above horizon, a – height of child shadow, b – height of dad shadow.	height of the Sun above the horizon, often also called the simplest sundial. It uses rectilinear propagation of light. For example, father and child "cast" a shadow of different lengths. Students redraw the drawing from the blackboard.
Question 5: What happens to the shadow, if you change the location of light source, such as a light source will be lower?	**Answer:** Shadow will be longer.
Copernicus, however, to construct his astronomical table employed gnomon called reflective, and therefore one, that uses ... phenomenon of light reflection.	
Question 6: Who will remind the law of reflection of light?	**Answer:** The angle of incidence is equal to the angle of reflection. The radius of incident and reflected beams and perpendicular to the surface of reflection of light lie in one plane.
To reflect a light beam Copernicus used the mirror.	
Experiment with the laser, mirror and a piece of paper. Teacher reflects the laser beam from a flat, contemporary mirror to demonstrate changes in the angle of reflection depending on the angle of incidence. ***Note***: *The teacher remind the need for caution when using the laser experiment.*	One student holds the card.
Question 7:: How does the angle of reflection change?	**Answer**: If the angle of incidence is greater than the angle of reflection is greater, and if the angle of incidence decreases, then the angle of reflection decreases.
Question 8: Do the incident and reflected radiuses lie in different planes?	**Answer:** No, they lie in the same plane.

II. Mirror

Question 9: What is mirror?	**Answer:** Mirror is the flat surface reflecting light.
Of course, at the time of Copernicus there were no such mirrors as they are today. At that time as a mirror, "our hero" could use: liquid mercury, red wine or honey mead. What was adopted by Astronomer as the reflecting surface is hard to say, the subject experts are not agreeable.. But apparently, it was not mercury because of the lack of availability and poisonous, although perfectly reflected light. Red wine, as well as honey mead reflect light less (darker color). Red wine by its sensitivity to wind blests and shocks can be considered less than the honey mead, which is more viscous, and thus one can expect a clearer reflection of sunlight and the "image of the Sun" could be more stable.	Students write a short note: Eg. 2. As the mirror a flat surface such as a light reflecting liquid - red wine, water, honey, etc. could be used for Copernicus experiment.

III. Astronomical table of Nicolaus Copernicus

But back to Nicolaus Copernicus. From the read literature we know, that the mirror was very small and was located on the outer parapet of the porch, next to the resident of astronomer. But inside the porch, on the wall, the points that reflected the apparent motion of the Sun were marked. These points are obtained by gnomoni – reflection method - the ray of the sun reflected from the mirror in the so-called "light rabbit" fell on the opposite wall. Consequently, on the wall which astronomer smoothed out putting a layer of plaster, there are lines: a straight line and the hyperbolas , similar to those plotted in the chart below. The teacher draws a graph on the blackboard:  The straight line (red) meant the apparent motion of the Sun in the sky in the Spring equinox and hyperbolas above the straight line - the apparent motion of Sun before equinox (and therefore still in winter), and below the equinox line (and hence in the spring). Probably observations began 25 January and ended April 20, 1517 year, indicating points every five days. In his case, the spring equinox according to the Julian calendar (then obeyed) weas on March 11, 1517 year..	Students write a short note. Eg. 3. Nicolaus Copernicus Astronomical table: a) the place - the castle in Olsztyn, the wall of the porch, b) a diagram and description Students redraw chart from the table. Note to chart: **straight line** - the apparent motion of the Sun at Spring equinox, **hyperbolas** - the apparent movement of the sun in the winter (above the straight line) and spring (below the straight line), c) the experience is likely to be carried out from 25 January to 20 April 1517. c) the experiment is likely to be carried out f rom 25 January to 20 April 1517.
Question 10 And now when the Spring equinox falls? **Question 11**: Why is there this difference?	**Answer:** 21 March. **Answer:** there was another calendar obeyed, the calendar year other than it is today.

Just to answer this question tried Nicolaus Copernicus, who along with other prominent astronomers of those times took a part in the work to reform the calendar. During the time of Copernicus the Julian calendar obeyed, the calendar, which had an average year 365.25 days. At the Council of Nicaea in 325 year so.called "Movable feasts" were established. Particularly concerned with Easter, which are set to begin on the first Sunday after the spring first full moon, so after the spring equinox. Initially, the spring equinox was on March 21, but over the years this date began to shift. In the thirteenth century, talked about the need for change, but until the time of Copernicus could not enter them. Only in 1582, Pope Gregory XIII reformed the calendar and therefore it is called the Gregorian.	**Students ask**: What was the maln goal of Nicolaus Copernicus investigations?
Some People think that just astronomical table of Olsztyn is a continuation of the work of Copernicus on the reform of the calendar. But we have no direct evidence of this thesis. It is known that work on the calendar began in 1515 in Frombork, and sent a report on his work in the spring of 1516 year to the Pope Leo X..	
So, for what this table? Certain researchers believe that astronomical table in Olsztyn Copernicus drafted for the purpose of teaching descendants and also after 493 years we can watch it and also to chart aiming at the learning objectives.	
IV. Invitation	
I would like to invite you to do this experiment. There is a possibility of self-play experiment of Nicolaus Copernicus and verify if the Spring equinox day the has not moved? ... However, I must point out that for this experiment the responsible and persistent Persons are needed, because it will be last approximately two months. We will start during the winter break.	Students willing to perform the experiment are already part of a prepared list ..
3. Summary	
Nicolaus Copernicus in his work used various astronomical instruments, made by himself, one of them is astronomical table. To repeat the experiment leading to the cancellation of such a table we will use the method of Copernicus -gnomon reflection, using sunlight reflected from mirrors placed on the window sill. We have the ability to repeat this experiment. The first meeting will be held on Monday, 16 February at 10.00 in the physics laboratory room..	
4. Homework	
To find on the Internet or other source of knowledge, what were and for what purpose were used by Nicolaus Copernicus instruments: an astrolabe, quadrant, and triquetrum.	