Tools for navigation on both Earth and sky

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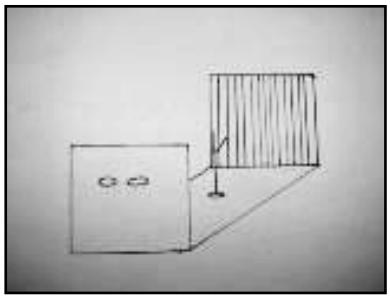
As a part of the new education programme at our school we ran a so-called thematic week. Our pupils choose a subject or topic they are interested in and during this week they can improve both their theoretical knowledge and practical experience in the chosen subject.

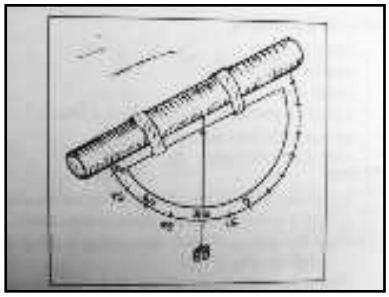
Nineteen pupils from the first and second year of their studies (aged 11-13 years) have entered the course in astronomy. Theoretical background for the course has been set up according to the Astronomy Olympiad, and in the practical part we constructed simple tools that can be used in astronomy. At the end of the week our pupils could present their tools to their schoolmates. We created a tool for explanation of the terms parallax and parsec, a simple device for measuring latitude, and astrolabe, and the so-called Jacob's staff.

Tool for the explanation of the term "parallax"



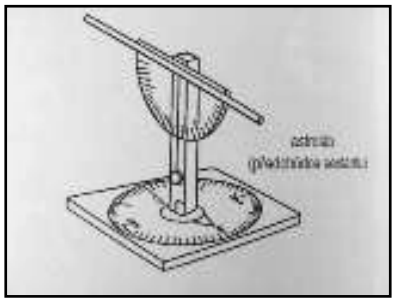
Two boards are placed at a distance of at least 60 cm. In the first board are two holes at the height of eyes. On the second board are stripes of equal width and different colours. An object is placed between the boards and is being observed through the holes in first board, at first by one eye and then by the other one. The pupils are fascinated by the "displacement" of the object against the second board.

Tool for latitude measurement



To determine our latitude we create a simple tool from a paper tube that has a protractor and plumb. The tube is aimed at the pole star (it has to be seen through the tube). The plumb line then shows us the latitude of our observation spot. The tool can be as well used for measuring observation angles of buildings, trees, etc.

Astrolabe

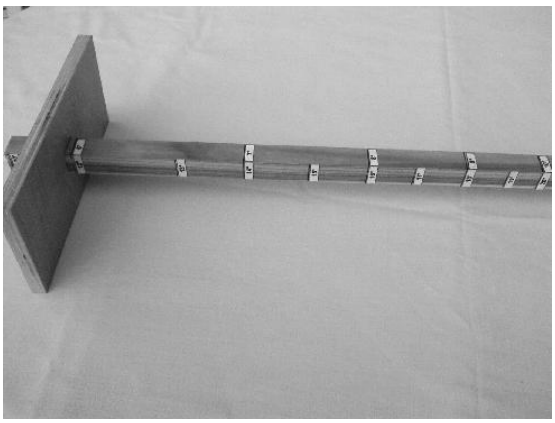


Requirements: a piece of cardboard for the base, wooden stick about 20 cm long, screw, cork plugs for legs, drinking straw, protractor, compass rose, drawing pins, and a drilling machine with a drill as wide as the screw.

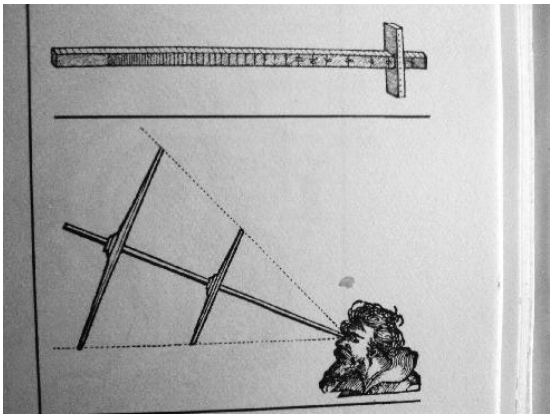
The use of an astrolabe for indoor (classroom) measurements: Mark the point of "real north", and then it is possible to locate different points in spherical coordinates.

Geography	Latitude – circles of latitude	Astronomy	Declination δ (0° - 90°)
	Longitude – meridians		Right ascension α (0-24 h)

Jacob's staff



To determine the distances of celestial bodies, angular dimensions are most commonly used. This way we can compare the distances between stars or the height of a star above horizon. For this kind of measurements we used a device called a Jacob's staff. An adjustable board on the staff enables us to measure the height of a star above horizon or the distance between two celestial bodies (in degrees). Depending on the size of the board the distance can be determined very precisely (a precision of angular minutes can be reached).



Jacob's staff can also be used in optics to explain the term view angle.

Remark

Astronomic observations cannot be done without using angular distances or dimensions of objects. To help we can also use parts of our body. If an arm is raised forward, the little finger is 0.5° wide. We can as well use the width of a thumb, palm or stretched fingers – thumb and little finger (Jacob's staff). This way we can also explain the term "parallax". If we look on a raised index finger with one and another eye, we can observe it to be moving against background objects.