

PRACTICAL EXERCISES FOR PUPILS

Name of the activity	Supposed time demandingness	Difficulty of the activity	Suitability for the age group	Tools and necessary materials	Objective of the activity
Distances and sizes in the Universe	20 – 30 minutes	Simple to medium difficult	13 – 15	encyclopaedia, star charts or internet/computer software such as Stellarium/Star chart, calculator	Reminding of typical distances and sizes of spatial objects, simple calculation of various distances
Balloon model of expansion of Universe	20 – 30 minutes	Medium difficult	14 – 15	Rubber balloon, felt-pen (or self-adhesive decoration stars), paper/tape measure, calculator	Modelling of expansion of Universe and determination of the distances within
Model of Orion constellation	1 – 2 hours	More time demanding, depending on the precision of the realisation	13 – 15	Bamboo stick, paper, glue or adhesive tape, tape measure, coloured paper or crayons/felt-pens, glue, polystyrene board, internet or computer software such as	Creation of three-dimensional constellation model, stars within a plane not in the same distance from us

				Stellarium/Star chart	
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Practical Exercise 3: MODEL OF ORION CONSTELLATION

Objective of Practical Exercise: create a three-dimensional model of Orion constellation in an appropriate scale.

Tools:

- bamboo stick,
- paper,
- glue or adhesive tape, eventually a craft glue gun,
- tape measure (or builder's tape for larger models),
- coloured paper or crayons/felt-pens,
- soft pencil,
- pocket knife,
- polystyrene board with the dimensions of 30 cm × 150 cm and eventually internet or computer software such as Stellarium/Star chart.

This well-known constellation represents, according to the Greek mythology, the mythic huntsman Orion, son of sea-god Poseidon, and a hunter Euryale, companion of Artemis, goddess of the hunt. According to one of the versions, he has been placed in the sky after offending the goddess Hera, who sent a giant scorpion whose sting Orion succumbed. Goddess Artemis achieved that Orion with his two dogs has been placed in the sky (constellations Canis Major and Canis Minor). The scorpion, which killed Orion, can be found in the sky as well, but to prevent their meeting the gods placed them, according to a legend, to the opposite sides of the sky. That is why, when Scorpio rises to the sky, the Orion hides under the horizon.



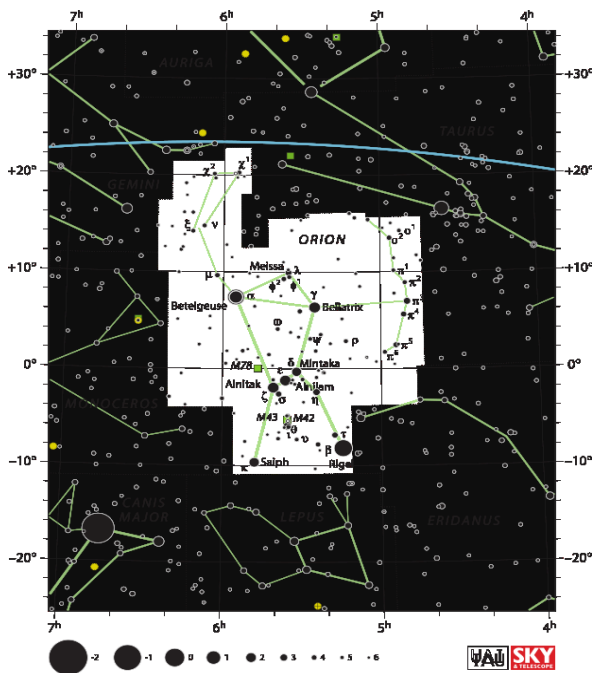
Representation of the Orion huntsman in the atlas from the 1st half of the 19th century
(Source: Wikipedia)

Stars constituting the Orion constellation are situated, in reality, in various distances from the Sun. Their similarity with the human figure is given by the direction of observation from the Solar System. From other point of view, the stars of the constellation would represent a completely different picture. We can make a three-dimensional model to visualize it. Let us add that the names of the stars in Orion are of Arabic origin (e.g. *Betelgeuse* in translation means an arm of a giant

or an armpit, *Rigel* means leg).

Chart of the Orion constellation (Source:

https://commons.wikimedia.org/w/index.php?title=File:Orion_IAU.svg&oldid=306677181)



Description of seven brightest stars of Orion together with their distances from the Solar System

Belgeuse is a red supergiant which will explode like a supernova in the astronomically foreseeable time (up to 1000 000 years). The distance is approx.450 ly.

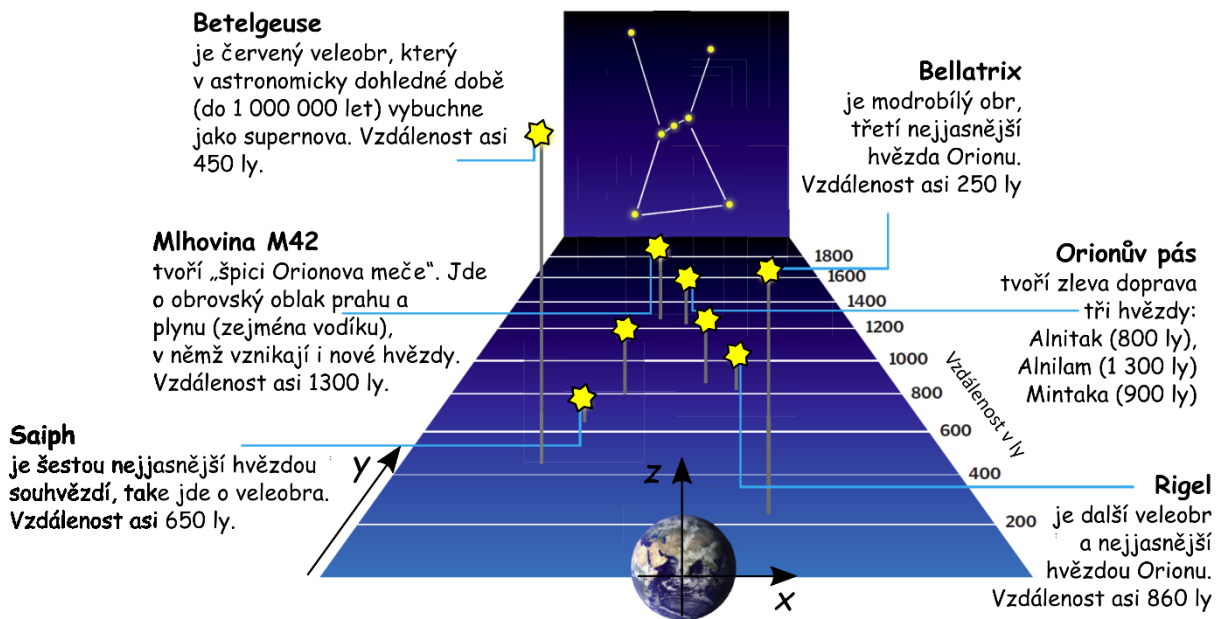
M42 Nebula creates the „pike of the Orion’s sword“. It is a huge cloud of dust and gas (mostly hydrogen) within which the new stars emerge. The distance is approx. 1300 ly.

Saiph is the sixth brightest star of the constellation and it is a supergiant as well. The distance is approx.650 ly.

Bellatrix is a bluish giant and the third brightest star of Orion. The distance is approx. 250 ly.

Orion’s belt consists of three stars (from left to right): Alnitak (800 ly), Alnilam (1300 ly), Mintaka (900 ly)


Rigel is another supergiant and the brightest star of Orion. The distance is approx.860 ly.

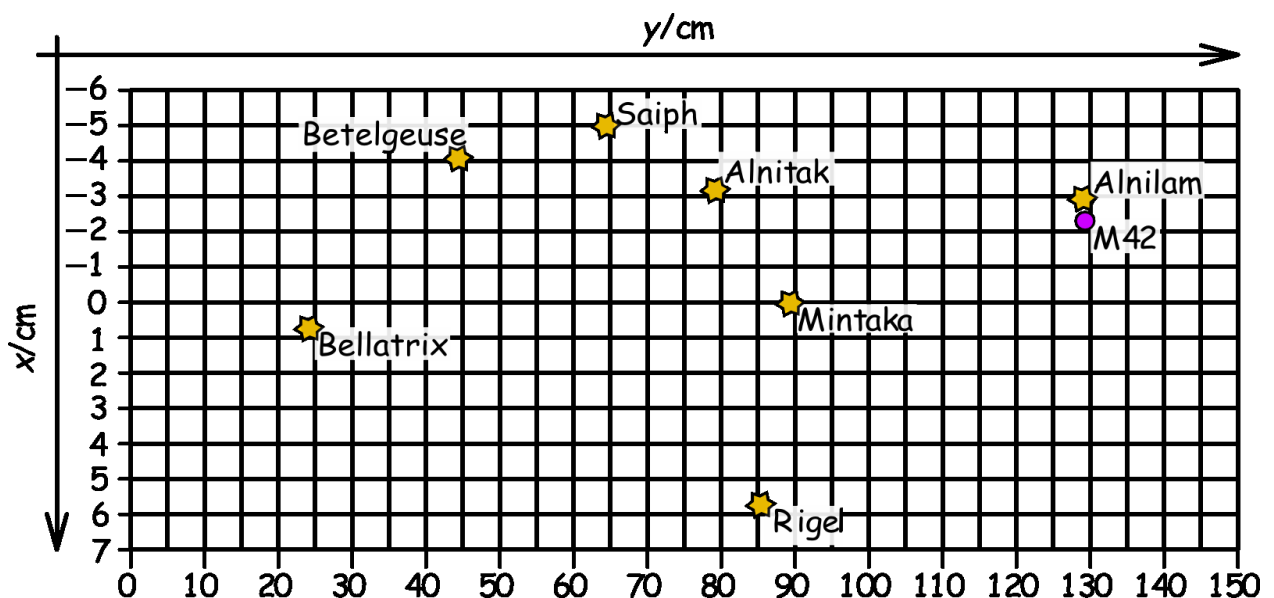


Star	Distance r/ly	x/cm	y/cm	z/cm
Betelgeuse	450	— 4.1	45	21
Rigel	860	5.7	86	8,4
Bellatrix	250	0.7	25	16
Mintaka	900	0.0	90	21
Alnilam	1 300	— 2.9	130	24
Alnitak	800	— 3.2	80	17
Saiph	650	— 5.0	65	6.6
M42	1 300	— 2.3	130	14

Table of distances of stars and their possible coordinates in our model in a scale where 1 cm corresponds to the distance of 10 ly

Instructions:

1. Work in groups of 3 – 6.
 2. First prepare the models of stars as a little balls of coloured paper (e.g. yellow) with 0.5 to 1 cm in diameter. You can pick another colour for the nebula M42. Instead of balls you can use a template of the star (for each star in Table 2, one from the „front“ and one from the „back“).
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3. Prepare the bamboo sticks with the length corresponding to the coordinates in the right column of the table. One end of bamboo sticks can be sharpened by a knife, so we can plant it into a board easily.
 4. Slip and glue the balls (or the cut-out stars) representing the stars of the constellation on the bamboo sticks (the blunt edge).
 5. Use the pencil to draw the coordinate frame x and y (e.g. in x direction by 1 cm and in y direction by 10 cm) on the polystyrene board.
 6. Plant the bamboo sticks with models of stars to the right places; we pay attention to stick them evenly deep (we can mark the sharpened bamboo sticks with a pencil, it is always necessary to plant the bamboo stick up to this mark 1 cm from the end). Mark the individual stars with their names either by a felt-pen on the board or by using the paper labels.
 7. Find a place from which you will see the stars from the same or similar arrangement as in the sky. Then look at the model from various sides and try to suggest what it resembles from above, from side and from the opposite side.



Additional Exercises:

1. Using the computer software (e.g. Stellarium or Skychart) search for the shape of Orion constellation in the year 100 000 BC and in the year 100 000 AD. Does it differ in any way from its actual shape?

Pick another well-known constellation (Little/Big Dipper, Cassiopeia, Cygnus, Lyre, etc.) and using the skychart, internet or computer software find the distances of 5 stars from this constellation.