WORKSHEETS FOR PUPILS

Activity name	Estimated duration	Difficulty of activity	Age of children for which activity is suitable	Aids and material	Objective of activity
Trajectory of dwarf planets	20 – 30 minutes	medium	14 – 15	encyclopedia, atlas or the Internet, calculator, spreadsheet	summary of distances and dimensions of dwarf planets, calculations of various distances
Dwarf planet's set	20 – 30 minutes	medium	14 – 15	encyclopedia, atlas or the Internet, calculator, spreadsheet	work with graph, calculation of equation
Model of trajectory	20 – 30 minutes	medium	14 – 15	paper, computer, calculator	making trajectory model, work with models
What is your weight?	20 – 30 minutes	medium	14 – 15	1 metre long ruler, calculator, spreadsheet, graph paper	average figure, gravitational factor, jump height, order of objects

Worksheet 3: MODEL OF TRAJECTORY

Exercise: Orbital trajectory of dwarf planet Pluto differs from orbital trajectories of planets – eccentricity 0.25, inclination 17°. The eccentricity of planets' orbital trajectories is from 0.007 (Venus) to 0.206 (Mercury), in fact, most planets' eccentricity is smaller than 0.1. The inclination of the orbital trajectory to the plane of the ecliptic ranges in most planets from 0° (Earth, from the definition of the ecliptic) up to 7° (Mercury). That is, Pluto gets, in a short phase (from the 7th February 1979 until the 11th February 1999) of its trajectory, closer to the Sun than Neptune, if we project its orbital trajectory into the plane of the ecliptic.

a) Assume that Pluto moves on a circular orbital trajectory. Calculate what per cent of time is Pluto closer to the Sun than planet Neptune? How many days is it?

b) On the models of the Neptune's and Pluto's trajectories verify that Neptune and Pluto cannot collide. Make a simple model of the trajectories of planet Neptune and dwarf planet Pluto. On a sheet of paper size A4 draw a circle with the radius 7.5 cm which will represent Neptune's orbital trajectory. Cut out the drawn circle and in one spot cut up to the center of the circle. On

another sheet of paper create the trajectory of Pluto; we recommend to draw a rectangle with sides 19.8 cm and 19.2 cm in an application (you can do so also in a text editor) on the computer. Draw an ellipse into it in such a way that the ellipse touches all the sides of the rectangle. Mark both axes of the ellipse with dash-dotted lines. You will get the position of the Sun if you draw a semi-circle with the diameter 19.8 cm around the center of the longer side of the rectangle and find the point of intersection with the longer axis of the ellipse. Finally, draw a perpendicular to the longer axis of the ellipse in such a way that it crosses the Sun. Print the picture in the proper racio on the A4 sheet of paper, cut out the trajectory including the drawn perpendicular. Insert both models of the trajectories one into the other in such a way that they form an angle of 17°.