Lesson Plan

Lesson: Kepler's Laws of orbital motion

Timeframe: 2 hours

Materials needed:

Objectives:

Basic:

1. Understanding of the parameters of the problem

2. Understanding of the three laws of the orbital motion

3. Answer basic questions on Kepler's Laws

Advanced:

1. Solve basic problem on Kepler's Laws

2. Prove the three laws of the orbital motion

3. Solve advanced problem on Kepler's Laws

Background: Courses on calculus, geometry and mechanics.

Introduction to Lesson:

In astronomy, Kepler's laws of planetary motion are three scientific laws describing the motion of planets around the Sun.

1   The orbit of a planet is an ellipse with the Sun at one of the two foci.

2   A line segment joining a planet and the Sun sweeps out equal areas during equal intervals of time.

3   The square of the orbital period of a planet is proportional to the cube of the semi-major axis of its orbit.

Most planetary orbits are nearly circular, and careful observation and calculation are required in order to establish that they are not perfectly circular. Calculations of the orbit of Mars, whose published values are somewhat suspect, indicated an elliptical orbit. From this, Johannes Kepler inferred that other bodies in the Solar System, including those farther away from the Sun, also have elliptical orbits.

Procedure [Time needed, include additional steps if needed]:

Pre-Class Individual Space Activities and Resources:

Steps	Purpose	Estimated Time	Learning Objective
Step 1: Study **V.I. Arnold, Mathematical Methods of Classical Mechanics, Chapter 2. Springer 1989**	**Proof of the laws of the planetary motion**	**2 hours**	**Basic 1-2 Advanced 2**
Step 2: Watch **https://www.youtube.com/watch?v=KTaIPz6oC9U**	**Understand the problem and the parameters of it.**	**1 hour and 15 min.**	**Basic 1-2 Advanced 2**
Step 3: Print and complete the following quiz **http://highered.mheducation.com/sites/007299181x/student_view0/chapter4/multiple_choice_quiz.html**	**We will discuss the answers in the beginning of the class**	**15 min**	**Basic 3**

In-Class Group Space Activities and Resources:

Steps	Purpose	Estimated Time	Learning Objective
Step 1: Introduction	**Explaining to students what we are going to do in today's class**	**10 min**	**Basic 1**
Step 2: Discuss and answers of the pre class quiz	**Clarify the subject**	**10 min**	**Basic 1-2**
Step 3: **Give time to students to solve 5 basic problems**		**30 min**	**Advanced 1**
Step 4: **Give time to students to solve 3 advanced problems**	**They all be able to prove the three laws of planetary motion**	**30 min**	**Advanced 2**

Step 5: Discussion with the students about their results and opportunity of the students to compare their results with the real parameters of our solar system.	The students will have the opportunity to see that the things that they do in the class, people that work in the space agencies have to take them everyday into account in order to provide space mission with the maximum efficiency and safety.	30 min	

Closure/Evaluation:

Analysis:

Post-Class Individual Space Activities:
The students will have to go back and read V.I. Arnold, Mathematical Methods of Classical Mechanics, Chapter 2. Springer 1989

Connections to Future Lesson Plan(s):

Derivation of Kepler's Laws from General Theory of Relativity of Albert Einstein.
What does it change with respect to the classical derivation and why?