

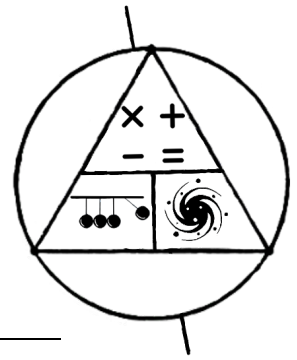
Lesson Plan: U3L2

Lesson: Orbits and Satellites

Time: 75 minutes

Course: SPH4U

Teacher: Roger Wilkinson



Before class prep:

- Make sure the link for the video is still working
- Get Whiteboard markers and/or markers and large pieces of paper

Materials Needed:

- Markers
- large pieces of paper
- computer & projector in class?
- whiteboard marker or chalk for me

Learning Outcomes:

Students can;

- explain the connection between being in orbit and free fall
- calculate orbital velocities given various situations
- describe the different types of orbits an object can have
- calculate the gravitational field strength at various points in the field
- connect gravitational fields and orbits to satellites and their applications

Specific Curriculum Expectations:

- A1.12 - use appropriate numeric (e.g., SI and imperial units), symbolic, and graphic modes of representation (e.g., vector diagrams, freebody diagrams, vector components, and algebraic equations)
- D2.1 - use appropriate terminology related to fields, including, but not limited to: forces, potential energies, potential, and exchange particles
- D2.2 - analyze, and solve problems relating to, Newton's law of universal gravitation and circular motion (e.g., with respect to satellite orbits, black holes, dark matter)

Activity	Time	Description
Engage	15 min	<p><u>Video:</u></p> <ul style="list-style-type: none"> ● Play video with Indigenous Story - The Great Bear and the Seven Birds https://www.lessonsfromearthandbeyond.ca/patterns-in-the-night-sky.html ● Use Douglas Adams quote about how to fly: “There is an art to flying, or rather a knack. The knack lies in learning how to throw yourself at the ground and miss. ... Clearly, it is this second part, the missing, that presents the difficulties.” Tell students that they will understand this after the lesson.
Explore	15 min	<p><u>Class Discussion + Video:</u></p> <ul style="list-style-type: none"> ● Watch Alice & Bob Video from the Perimeter Institute https://www.youtube.com/watch?v=BXnhEDMUJt8 ● Have a class discussion about how objects in orbit are always in free fall but just missing the earth. Have students connect the Alice and Bob video to the Indigenous story as well as the Douglas Adams quote. ● Ask students what types of paths a ball would travel on if they threw it in the air. They should know that it will take a parabolic path, but you should point out that this is only an approximation. ● In reality the object is trying to follow an elliptical orbit, but the earth is getting in the way. Because the earth is so big the part of the elliptical orbit we see the object take is identical to a parabolic curve. ● Connect this to conic sections to show that if you slice a cone obliquely you get an ellipse, and that if you think of rotating that slice so that one side of it goes through the bottom of the cone, then you get a parabola! Show visually with Geogebra site at: https://www.geogebra.org/m/GmTngth7#material/T8TV2JqG
Explain	15 min	<p><u>Formal Instruction:</u></p> <ul style="list-style-type: none"> ● Deriving formulas for the velocity of objects in circular orbits. <ul style="list-style-type: none"> – Explain that we are considering the special case of circular orbits because only circular orbits will have a constant velocity – you can also connect this to conic sections, as you can also rotate the ellipse into a circle when slicing through a cone ● Work through problems from the textbook with the class: <ul style="list-style-type: none"> – pg 300, Tutorial 1 question

Elaborate	20 min	<p><u>Group Work:</u></p> <ul style="list-style-type: none"> ● Split students into smaller groups by having them select a card and cards of the same numbers group together ● Have students work on practice problems pg 302, 1-4 on either a section of whiteboard or a large piece of paper ● Each group will then have a chance to share one of their solutions with the class explaining each step with diagrams and equations ● Ask students qualitative questions about how their solution would change if various aspects of the physical situation changed
Consolidate Evaluate	5 min	<p><u>Concept Checking Questions & Note Creation:</u></p> <ul style="list-style-type: none"> ● Have students now sit by themselves and create notes about what they learned today in class. Encourage them to include diagrams and equations, as well as full sentence explanations in their own words about everything they remember. Students should not use the textbook. ● As students are doing this walk around and ask them yes/no concept checking questions
Clean up, Pack up, and Exit	5 min	<ul style="list-style-type: none"> ● Use this time to answer any questions that students have. ● Remind students of the practice problems for homework. ● Encourage students to complete their notes at home. ● Suggest further sources for students to look into: videos, websites, books, etc.

Homework

Textbook: pg 303, 1-14