A. Intro to Aviation & Rotational Mechanics

Content Area: **Science**
Course(s): **CAD Architect**
Time Period: **Marking Period 1**
Length: **1**
Status: **Not Published**

Standards

SCI.9-12.HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
SCI.9-12.HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
SCI.9-12.HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
SCI.9-12.HS-PS2-1	Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

Enduring Understandings

Students will come to understand:

1. Despite their tremendous design variety, all aircraft are designed to balance four forces (lift & weight, thrust & drag) and balance all moments about the aircraft center of gravity.
2. Rotational motion follows the same laws of physics as translational motion; for each quantity of translational motion, there is a rotational equivalent and all of these quantities are related by an analogous form of Newton's Laws.
3. The principles of static equilibrium are the same, regardless of the machine or structure considered.

Essential Questions

The following questions will guide student inquiry:

- What physical conditions must be satisfied for a machine to maintain sustained flight?
- How does conceptualizing an object as an object of size (as opposed to a point mass) change the analysis of the force acting on the object?
- How can the forces acting on an object (such as an aircraft) balance, yet the object's state of motion change over time?

Knowledge and Skills

Unit Content:

This first unit is designed to open students' minds to the wide variety of flying machines that make up the aviation and aerospace industries while at the same time introducing the terminology associated with these fields. The scope of the course will be limited to man-made machines, capable of controlled flight in the Earth's atmosphere, without any physical connection to the ground below, to serve a practical purpose. This eliminates discussing birds and insects, kites, weather balloons, etc. Content relating to this purpose includes:

- Types of Flying Machines (1 day)
- Aircraft Terminology (homework)

In addition to an introduction to flying machines and the scope of the course, the first unit motivates a study of rotational dynamics; it is not enough for the four forces of flight to balance, but the various torques (or moments) acting on the aircraft must balance. This is a basic physics concept applied to aerospace engineering.

- Conditions Required for Un-accelerated Flight (force of lift balances weight, thrust balances drag; aerodynamic pitching moments balanced) (1 day)
- Rotational Motion and Angular Displacement
- Angular Velocity an Angular Acceleration (all angular kinematics, 2 days)
- Rigid Object Equilibrium (2 days)
- Effects of Forces and Torques on the Motion of Rigid Objects (2 days)
- Center of Gravity (2 days)

Practical Science, Technology, Engineering, Mathematics, and/or Aviation Skill(s):

- Computing the Center of Gravity of Aircraft from aircraft Flight Manual Data, computational method and graphical method (2 days)
- Using Microsoft Excel to organize and mathematically manipulate data

Resources

Textbook(s):

Hurt, H. H. (1965). *Aerodynamics for Naval aviators*. Washington, DC: Federal Aviation Administration.

Smith, H. C. (1992). *The illustrated guide to aerodynamics* (2nd ed.). Blue Ridge Summit, PA: McGraw-Hill, Inc.

Cessna Aircraft Company. (1977). *Pilots operating handbook: Cessna 172*. Wichita, KS: Cessna Aircraft Company.

Federal Aviation Administration. (2013). *The pilots handbook of aeronautical knowledge*. Washington, DC: Author.

Lab Equipment:

Pasco Low Speed Wind Tunnel

Balsa tools to create airfoil sections

Foam cutter and foam cutting tools to create airfoil sections

Balsa gliders

Video Camera/digital camera

Computer Software:

Microsoft Excel

Foilsim

NASA Site

Assessment

Do Now Activities

Exit Ticket Activities

Quizzes

Practice Worksheets