B. Fluid Statics & Earth's Atmoshphere

Content Area: **Science**
Course(s): **CAD Architect**
Time Period: **Marking Period 1**
Length: **1**
Status: **Published**

Assessment

"Do Now" Activities

"Exit Ticket" Activities

Practice Problem Worksheets

Quizzes

Standards

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-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
SCI.9-12.HS-PS2-6	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
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. That the loose attraction between the molecules of a fluid differentiate it from a solid and result in a fluid's ability to flow, be compressible, and have viscosity.
2. Fluid pressure is a distributed force (as opposed to a point force) that acts perpendicular to a surface, and that static pressure is the result of the gravitational force.
3. Fluid pressure is transmitted undiminished in an enclosed, static fluid; allowing fluid pressure to exert large forces in machines.
4. The variation in atmospheric properties at different locations in the atmosphere necessitates the definition of a standard atmosphere and also implies the need for various definitions of altitude (true

altitude, pressure altitude, density altitude, etc.)

Essential Questions

The following questions will guide student inquiry:

- How does the strength of intermolecular attractive forces define the properties associated with a fluid?
- How can two materials be at the same temperature yet have different amounts of thermal energy?
- How can the properties of fluids be measured?

Knowledge and Skills

Unit Content:

With the exception of spacecraft that are deployed from the cargo bay of another spacecraft, all aerospace machines are designed to operate in the ocean of air that surrounds the Earth, the atmosphere. The properties of the this atmosphere are quantified by numerous physcial quantities that are related by the laws of fluid statics (pressure, density, temperature, and viscosity). Further, each of these properties drastically affect the operation of any aircraft operating in the atmosphere. Because all aerodynamics is based on these quantities, all aerodynamics courses begin with a detailed study of the atmosphere and the relationship between the properties that describe it. This unit introduces the theory and practical applications of fluid statics, the science of fluids at rest. Fluid dynamics, the study of fluids in motion, will occupy the unit that follows.

- Definition of a fluid and definition of mass Density (1 day)
- Mathematical Definition Pressure
- Relation between Pressure and Depth Static Fluid (2 days)
- Pascal’s Principle (1 day)
- Archimedes’ Principle
- Common Temperature Scales
- The Kelvin Temperature Scale (1 day)
- Kinetic Theory of Gasses
- Heat & Internal Energy (1 day)
- The ICAO Standard Atmosphere & Definition in terms of Ratios (1 day)

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

The principles of pressure, Pascal's principle, and Archimede's principle are important not only from a science perspective, but they alone provide the physical basis for the essential measurement instruments of aerospace engineering (pressure and temperature). In addition, Pascal's principle is the foundation of hydraulic systems, which are essential in aerospace to manipulate aircraft control surfaces, raise and lower the landing gear, etc. Finally, this unit on fluid statics provides the theoretical background to understand an entire group of flying machines, lighter than air flight (balloons, blimps, and dirigibles).

- Application of Concept of Pressure: Pressure Gauges, operation, selection, and usage (2 days)
- Aerospace Application: Measuring Altitude and Types of Altitude (1 day)

- Aero Application: Pascal's Principle and Aircraft Hydraulic System Examples from specific aircraft manuals (2 days)
- Aero Application: Balloons, Blimps, Dirigibles (1-2 days)
- Application of Concept of Temperature: Thermometers (2 days)

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:

Cutaway and Stock aircraft altimeters

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

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