Anoka-Hennepin Secondary Curriculum Unit Plan

Department:	Science and Technology Education	Course:	PLTW Gateway to Technology (DSF)	Unit 10 Title:	Flight and Space Aeronautics	Grade Level(s):	7-8
Assessed Trimester:	Trimester 3	Pacing:	8 Days	Date Created:	6/16/2014	Last Revision Date:	

Course Understandings: *Students will understand that:*

- Math, Science, and ILA all are an important part of design criteria and constraints when developing goods.
- Various forces have varied effects on design and outcomes.
- How does design effect efficiency of energy sources.
- Bernoulli's principle, which states that as the speed of a fluid increases, its pressure decreases, explains in part how an airfoil gains lift.
- Airfoils design attributes involves different parts and lift, leading edge, trailing edge, and angle of attack.

DESIRED RESULTS (Stage 1) - WHAT WE WANT STUDENT TO KNOW AND BE ABLE TO DO?

Established Goals

Science

Motion and Stability: Forces and Interactions

- **Standard: 6.2.2.2:** Forces have magnitude and direction and govern the motion of objects.
  Benchmark:
  6.2.2.2.2: Forces & Effect on Motion Identify the forces acting on an object and describe how the sum of the forces affects the motion of the object. *For example:* Forces acting on a book on a table or a car on the road.
  6.2.2.2.4: Mass vs. Weight Distinguish between mass and weight.

Energy

- **Standard: 6.2.3.2**: Energy can be transformed within a system or transferred to other systems or the environment

Engineering Design

- **Standard: 6.1.2.2: Engineering design is the process of devising products, processes and systems that address a need, capitalize on an opportunity, or solve a specific problem.**
  Benchmark:
  6.1.2.2.1: Applying a Design Process- Apply and document an engineering design process that includes identifying criteria and constraints, making representations, testing and evaluation, and refining the design as needed to construct a product or system that solves a problem.*For example:* Investigate how energy changes from one form to another by designing and constructing a simple roller coaster for a marble.
- **Standard: 6.1.2.1:** Engineers create, develop and manufacture machines, structures, processes and systems that impact society and may make humans more productive.
  Benchmark:
  6.1.2.1.2: Risks in Technologies- Recognize that there is no perfect design and that new technologies have consequences that may increase some risks and decrease others.
  6.1.2.1.3: Trade-offs in Technologies- Describe the trade-offs in using manufactured products in terms of features, performance, durability and cost.
  6.1.2.1.4: Learning from Failures- Explain the importance of learning from past failures, in order to inform future designs of similar products or systems.
- **Standard 9.1.3.4 Science, technology, engineering and mathematics rely on each other to enhance knowledge and understanding.**
  Benchmark:
  9.1.3.4.3: Appropriate Representations- Select and use appropriate numeric, symbolic, pictorial, or graphical representation to communicate scientific ideas, procedures and experimental results.
  9.1.3.4.6: Analysis of Models - Analyze the strengths and limitations of physical, conceptual, mathematical and computer models used by scientists and engineers.
- **Standard 9.1.2.2 Engineering design is an analytical and creative process of devising a solution to meet a need or solve a specific problem**
  Benchmark:
  9.1.2.2.2: Using Models in Designing - Develop possible solutions to an engineering problem and evaluate them using conceptual, physical and mathematical models to determine the extent to which the solutions meet the design specifications.

Math

Ratios and Proportional Relationships

The Number System

- Compute fluently with multi-digit numbers and find common factors and multiples.
  3. Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation. (6.NS.B.3)

Expressions and Equations

- Apply and extend previous understandings of arithmetic to algebraic expressions.
  2. Write, read, and evaluate expressions in which letters stand for numbers. (6.EE.A.2)
  2.a. Write expressions that record operations with numbers and with letters standing for numbers. For example, express the calculation "Subtract y from 5" as 5 - y. (6.EE.A.2a)
- Represent and analyze quantitative relationships between dependent and independent variables.
  9. Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time. (6.EE.C.9)

The Number System

- Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.
  2. Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers. (7.NS.A.2)
  2.a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (-1)(-1) = 1 and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts. (7.NS.A.2a)

Expressions and Equations

- Solve real-life and mathematical problems using numerical and algebraic expressions and equations.
  4. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (7.EE.B.4)

Literacy in Science and Technical Subjects: Reading and Writing

Reading

- Comprehension and Collaboration
  6.13.7.7: Compare and integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, table, map)

Technological Literacy

- **Standard:** Students will develop an understanding of the core concepts of technology.
  Benchmark:
  N. Systems thinking involves considering how every part relates to others. (2.6-8.N)
  Q. Malfunctions of any part of a system may affect the function and quality of the system. (2.6-8.Q)
  R. Requirements are the parameters placed on the development of a product or system. (2.6-8.R)
- **Standard:** Students will develop an understanding of the attributes of design.
  Benchmark:
  E. Design is a creative planning process that leads to useful products and systems. (8.6-8.E)
  F. There is no perfect design. (8.6-8.F)
  G. Requirements for design are made up of criteria and constraints. (8.6-8.G)
- **Standard:** Students will develop an understanding of engineering design.
  Benchmark:
  F. Design involves a set of steps, which can be performed in different sequences and repeated as needed. (9.6-8.F)
  H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions. (9.6-8.H)
- **Standard:** Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
  Benchmark:
  F. Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system. (10.6-8.F)
  H. Some technological problems are best solved through experimentation. (10.6-8.H)

- **Standard:** Students will develop the abilities to apply the design process.
  Benchmark:
  H. Apply a design process to solve problems in and beyond the laboratory-classroom. (11.6-8.H)
  I. Specify criteria and constraints for the design. (11.6-8.I)
  J. Make two-dimensional and three-dimensional representations of the designed solution. (11.6-8.J)
  K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed. (11.6-8.K)

Transfer

Students will be able to independently use their learning to: (product, high order reasoning)

- Using the design process to create an airfoil for maximum lift students will be demonstrating Bernoulli's Principle.

Meaning

Unit Understanding(s):	Essential Question(s):
Students will understand that: ● Forces working on an airplane in flight are lift, gravity, thrust, and drag. ● In order to fly, an airplane must overcome gravity with sufficient lift and must overcome drag with sufficient thrust. ● Newton's three laws of motion are observed in both spacecraft and aircraft. ● Bernoulli's principle, which states that as the speed of a fluid increases, its pressure decreases, explains in part how an airfoil gains lift. ● Changing a wing's angle of attack affects the speed of the air flowing over the wing and the amount of lift the wing creates. ● Airfoils are tested for performance in a wind tunnel/wing tester. ● Aircraft have different purposes, but the majority of their components are similar. ● Propulsion systems provide the thrust so aircraft can fly.	**Students will keep considering:** ● Why are aircraft categorized into heavier-than-air and lighter-than-air vehicles? ● What makes an airplane fly? ● What is a propulsion system and how is it used to move an aircraft and a spacecraft? ● How do the forces of lift, drag, gravity, and thrust affect the flight of an airplane? ● What is an airfoil? ● Does the shape of a wing have anything to do with how much lift it generates? ● What are Newton's laws of motion?

Acquisition

Knowledge - Students will:	Skills - Students will:
● Describe how center of gravity affects an aerospace vehicle in distributing weight. ● Recognize the tools and purpose of aeronautic design and testing. ● Distinguish between the forces of lift, drag, weight, and thrust that affect an object moving through a fluid. ● Explain the importance of the forces that affect an object moving through a fluid. ● Explain how Newton's laws apply to flight and space. ● Explain how Bernoulli's principle affects flight. ● Identify the characteristics of an airfoil and how they compare and contrast with the characteristics of wings. ● Analyze the features and benefits of different types of wings. ● Describe the major parts (fuselage, empennage, high lift devices, wings, undercarriage, propulsion, instruments, and controls) of aircraft and how they can affect the overall balance of an airplane during flight. ● Use learnings as a stepping stone for future classes **Reasoning - Students will:** ● Organize information ● Evaluate options from various learnings ● Organize information presented in an engineering notebook	● Calculate fuel consumption and range of an airplane given speed and fuel capacity. ● Research and design an airfoil that will create lift using a wind tunnel/wing tester. ● Students will make adjustments to a wing foil to achieve greater lift.

Common Misunderstandings

- The difference between heavier than air and lighter than air vehicles.
- The top and bottom of an airfoil can be the same shape.
- Mass and weight are not always the same thing.

Essential new vocabulary

- Acceleration
- Aileron
- Airfoil
- Angle of Attack
- Aspect Ratio
- Bernoulli's Principle
- Camber
- Chord
- Dihedral Angle
- Drag
- Elevator
- Empennage
- Flaps
- Fluid
- Force
- Fuselage
- Glider
- Gravity
- Heavier-Than-Air
- Horizontal Stabilizer
- Hypersonic
- Leading Edge
- Lift
- Lighter-Than-Air
- Mach 1
- Mass
- Newton's 1st Law
- Newton's 2st Law
- Newton's 3st Law
- Pitch
- Precise Input
- Propellant
- Propeller
- Propulsion
- Ramjet
- Rocket Engine
- Roll
- Rudder
- Slats
- Spoiler
- Thrust
- Trailing Edge
- Turbine
- Vertical Stabilizer
- Velocity
- Weight
- Wing
- Yaw