Flight and Space Unit Description

Purpose

The purpose of this unit is to introduce the student to aeronautics, space, and the use of design used to help make aerospace engineering an important field. They learn about Newton’s Laws of Motion, forces, rockets, propulsion, and what makes things fly. Students acquire and apply knowledge and skills in engineering problem solving and explore the many aspects of aerospace engineering.

Concepts

1. Technology is the study of how humans change the natural world to meet human needs and wants.
2. Design is a creative process that leads to useful products and systems.
3. Systems thinking involves considering how every part relates to others.
4. Expressing ideas to others verbally and through sketches and models is an important part of the design process.
5. Estimating and using measurement tools correctly are used to recognize when a measurement is reasonable.
6. Two-dimensional representation of three-dimensional solutions can take many forms, including graphic, mathematical, and physical.

Concepts by Lessons

Lesson 1: Evolution of Flight (11 days) –
- The history of aerospace studies has influenced how people meet the challenges of traveling through the atmosphere or in space.
- Engineering designs in aerospace exploration evolve as they are developed.
- The future of aerospace can be both exciting and challenging.

Lesson 2: Airfoils Research, Construction, and Testing (8 days) –
- Forces working on an airplane in flight are lift, gravity, thrust, and drag.
- An airplane has to overcome gravity with enough lift, and overcome drag with enough thrust in order to fly.
- Bernoulli’s Principle that states as the speed of a fluid increases, its pressure decreases, explains in part how an airfoil gets 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.
- Teamwork is needed to effectively complete an activity.
Lesson 3: Propulsion Systems (12-15 days) –

- Newton’s three laws of motion are central to the idea of propulsion and aircraft design.
- An external force is required to change the state of an object from rest to motion and from motion to rest.
- The direction of acceleration is the same as the direction of the external force.
- Newton’s third law of motion can be used to explain the generation of lift by a wing and the production of thrust by a jet engine.
- The three principle propulsion systems are the propeller, the jet engine, and the rocket engine.

Lesson 4: Aeronautics and Rocketry (13 days) –

- Parts of a model rocket and parts of a model rocket engine have specific functions during a rocket’s flight.
- The forces of weight, thrust, drag, and lift interact differently on a rocket in flight than on an aircraft in flight.
- Newton’s three laws of motion (inertia, F = ma, and action-reaction) can be used to describe and predict events during each phase of a rocket launch.
- Rocket design features are interrelated and determine how well a rocket will perform during powered flight.

Essential Questions

Lesson 1: Evolution of Flight

1. What were the first technological advancements that continue to lead to the advancement of flight?
2. What engineering challenges did the Wright brothers face?
3. Who were the pioneers of rocketry?
4. What are some similar problems associated with both airplanes and rockets today and possibly in the future?

Lesson 2: Airfoils Research, Construction, and Testing

5. Why are aircraft categorized into heavier-than-air and lighter-than-air vehicles?
6. What makes an airplane fly?
7. How do the forces of lift, drag, gravity, and thrust affect the flight of an airplane?
8. What is an airfoil?
9. Does the shape of a wing have anything to do with how much lift it generates?
10. What can be learned from testing an object in the wind tunnel?
11. How well did your team work together to complete the project?

Lesson 3: Propulsion Systems

12. What is a propulsion system?
13. What are Newton’s Laws of Motion?
14. How is a propulsion system used to move an aircraft?

15. How is a propulsion system used to move a spacecraft?

16. Why is it important to understand Newton’s Laws of Motion in order to understand propulsion?

Lesson 4: Aeronautics and Rocketry

17. What are the basic parts of a model rocket and a model rocket engine? What is the significance of each of the major parts in producing stable flight?

18. If smoke is coming from a model rocket’s engine during flight, is that a reliable indicator that its engine is powering the rocket?

19. What forces affect a rocket’s flight?

20. What are Newton’s three Laws of Motion? How can they describe different phases of a rocket launch?

21. Once all fuel is gone and the engine no longer powers a model rocket, does it immediately begin its fall back to Earth? Why or Why not?

22. What are the structural design characteristics of a model rocket that will affect its performance?

23. What design characteristics will affect maximum altitude? How are the design characteristics related to the forces on a rocket in powered flight?

24. What is the maximum altitude a model rocket will travel when powered by a model rocket engine?

25. At what point during flight does the rocket reach maximum altitude? How can the maximum altitude be measured?

26. How fast do you think a model rocket will travel when powered by a model rocket engine?

27. At what point during flight does maximum speed or velocity occur? How can the maximum speed or velocity be calculated?

28. If given a chance, would you travel in a rocket?

Lessons

Lesson 1: Evolution of Flight
Lesson 2: Airfoils Research, Construction, and Testing
Lesson 3: Propulsion Systems
Lesson 4: Aeronautics and Rocketry

Unit Evaluation

The unit will be assessed based on rubrics, assessment suggestions, and the student work on activities, projects, and problems.