



Four Forces of Flight

LESSON THEME

The Four Forces of Flight game helps students learn the terms associated with flight (lift, thrust, drag, and weight)

OBJECTIVES

The students will

- Identify the four forces of flight: lift, thrust, drag, and weight
- Explain how the four forces of flight effect the direction of flight of an airplane
- Classify which forces of flight are positive and which forces of flight are negative (which forces oppose each other)
- Construct and play an aviation game

NASA SUMMER OF INNOVATION UNIT

Physical Science—Aeronautics

GRADE LEVELS

4 – 6

CONNECTION TO CURRICULUM

Science, Mathematics, and Technology

TEACHER PREPARATION TIME

1 hour

LESSON TIME NEEDED

1 hour

Complexity: Basic



NATIONAL STANDARDS

National Science Education Standards (NSTA)

Science as Inquiry

- Understanding of scientific concepts
- An appreciation of "how we know" what we know in science
- Understanding of the nature of science
- Skills necessary to become independent inquirers about the natural world
- The dispositions to use the skills, abilities, and attitudes associated with science

Physical Science Standards

- Position and motion of objects
- Motions and forces

Science and Technology Standards

- Abilities of technological design
- Understanding about science and technology

Common Core State Standards for Mathematics (NCTM)

Operations and Algebraic Thinking

- Use the four operations with whole numbers to solve problems
- Generate and analyze patterns

Operations and Algebraic Thinking

- Write and interpret numerical expressions
- Analyze patterns and relationships

National Geography Standards (NCGE)

The World in Spatial Terms

How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective

ISTE NETS and Performance Indicators for Students (ISTE)

Creativity and Innovation

- Use models and simulations to explore complex systems and issues

Critical Thinking, Problem Solving, and Decision Making

- Plan and manage activities to develop a solution or complete a project

MANAGEMENT

Copy game board, game pieces, and game cube on card stock paper. Laminate game board, game pieces, and game cube so they will be more robust and collect to reuse again in future classes. Students play the game in small groups (from 2 to 4).

MATERIALS

- game board
- game pieces
- game cube

CONTENT RESEARCH

Key Concepts:

The four forces of flight: lift, thrust, drag, and weight

- Lift is a force that acts upward against gravity and makes it possible for aircraft to rise in the air.
- Thrust is a forward force that pushes an aircraft through the air.
- Drag is the force of resistance to the motion of a vehicle body as it moves through a fluid such as water or air; drag acts in the opposite direction to thrust.
- Weight is a response of mass to the pull of gravity. It acts downward against lift. (Gravity is the force that pulls down on objects and gives them weight.)
- What are opposing forces? Lift works opposite of weight. Thrust works opposite of drag.

Opposing forces (lift and weight; thrust and drag; positive and negative)

- Lift works opposite of weight
- Thrust works opposite of drag
- Positive direction is either up or forward, and negative direction is down or backward

Misconceptions:

Weight and gravity are the same on Earth and are sometimes use interchangeable.

Weight is a response of mass, and gravity is a force that gives weight.

(This distinction is beyond the 4 – 6 grade level, but this is additional knowledge for the teacher and can be discussed if a student brings up the question from seeing weight and gravity used interchangeably in a four forces diagram.)

LESSON ACTIVITIES

The Four Forces of Flight board game is played by students who use the four forces of flight to be the first to fly from Thrust City airport to Liftville airport. The board game contains problem solving.

http://www.nasa.gov/pdf/636827main_Sci%20Filesguide4_00.pdf

ADDITIONAL RESOURCES

The Beginner's Guide to Aeronautics Homepage

- Aircraft motion: interactive simulators and animated movies
- Airplane parts: interactive and fact sheets
- Aircraft forces: interactive and animated movies
- Thrust: interactive simulator and fact sheets
- Weight: movies and fact sheets
- Lift: interactive, interactive simulator, and animated movies
- Drag: interactive simulator and fact sheets
- Gliders: fact sheets and paper templates
- Wind tunnels: interactive simulator and fact sheets

The Courage to Soar Educator Guide

Activity Eight—The Four Forces of Flight

- Lesson 15—The Four Forces of Flight at Work
 - Vocabulary list, student text, and diagram
- Lesson 16—The Pull of Gravity
 - Vocabulary list, student text, and six gravity experiments
- Lesson 17—It Lifts Me Up – The Force of Lift
 - Vocabulary list, student text, diagram, and six lift experiments
- Lesson 18—The Opposing Forces of Thrust and Drag
 - Vocabulary list, student text, and experiments
- Lesson 19—Thrust and Drag Experiments
 - Vocabulary list, student text, three thrust experiments, and three drag experiments
- http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/The_Courage_to_Soar.html

The 1902 Glider—How the Problem of Control Was Solved

- Poster and Web-based resources to integrate into classroom activities

http://www.nasa.gov/pdf/636827main_Sci%20Filesguide4_00.pdf

DISCUSSION QUESTIONS

- What is force? *Force is a push or pull used to lift something, start it moving, or hold it in place against another force.*
- What is lift? *Lift is a force that acts upward against gravity and makes it possible for aircraft to rise in the air.*
- What is thrust? *Thrust is a forward force that pushes an aircraft through the air*
- What is drag? *Drag is the force of resistance to the motion of a vehicle body as it moves through a fluid such as water or air; drag acts in the opposite direction to thrust.*
- What is weight? *Weight is a response of mass to the pull of gravity. It acts downward against lift.*
- What is gravity? *Gravity is the force that pulls down on objects and gives them weight.*
- What are opposing forces? *Lift works opposite of gravity. Thrust works opposite of drag.*

ASSESSMENT ACTIVITIES

- Have students describe the four forces of flight, listing the parts of an airplane that affects each of the four forces

ENRICHMENT

Play another game using concepts of thrust, lift, weight, and drag plus addition of coordinate grid chart and probability of the four different spinners

- Rescue at Sea
- http://scifiles.larc.nasa.gov/docs/guides/guide4_00.pdf
 - Materials: game board and spinners
 - Extensions:
 - Add fuel consumption to the problem
 - Make a new game board that favors a different spinner
 - Make new spinners that would best suit the game
 - For advanced students, create a game board that would involve positive and negative integers and that would extend into other quadrants of the coordinate plane