



USS HORNET *READY ROOM TIME!* PRESENTS

KICK THE TIRES AND LIGHT THE FIRES!

The Four Forces of Flight

READY ROOM TIME! TEACHER'S GUIDE

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READY ROOM TIME! TEACHER'S GUIDE

Program Description

It's a wild ride, but Navy aviators do it every day. Learn the secrets of taking off from a floating runway with only one tenth the length of a normal land runway. Study the four forces of flight and see how today's Navy uses the scientific principles of two men from the 17th and 18th Centuries (Sir Isaac Newton and Daniel Bernoulli) to get modern day jets safely in the air from an aircraft carrier flight deck in two seconds. Come along with us and do what Navy fighter pilots do every day when they Kick the Tires and Light the Fires!

The program has four goals:

- To have guests gain an understanding of the four forces of flight.
- To have guests gain an understanding of the Bernoulli Principal and how it affects the four forces of flight, in particular, lift.
- To have guests gain an understanding of the Newton's Third Law of Motion and how it affects the four forces of flight, in particular, thrust
- To have guests gain an understanding that taking off from an aircraft carrier is different from taking off from a land-based runway.

Standards Alignment

NS.5-8.1 SCIENCE AS INQUIRY

As a result of activities in grades 5-8, all students should develop--
Abilities necessary to do scientific inquiry
Understandings about scientific inquiry

NS.5-8.2 PHYSICAL SCIENCE

As a result of their activities in grades 5-8, all students should develop an understanding
Properties and changes of properties in matter
Motions and forces
Transfer of energy

NS.5-8.5 SCIENCE AND TECHNOLOGY

As a result of activities in grades 5-8, all students should develop--
Abilities of technological design
Understandings about science and technology

NS.5-8.7 HISTORY AND NATURE OF SCIENCE

As a result of activities in grades 5-8, all students should develop understanding of
 Science as a human endeavor
 Nature of science
 History of science

Vocabulary

The program will cover the following vocabulary:

Word	Meaning
Air	A mixture of invisible odorless tasteless gases (such as nitrogen and oxygen) that surrounds the earth
Air Pressure	The weight of air molecules pressing down on the Earth
Force	A push or a pull on an object. A force happens when two objects interact—that is, when one object does something to the other object. When the interaction stops, the force stops, too.
Energy	"The ability to do work"
Gravity	Gravity pulls objects toward the center of Earth. This is what makes objects fall. It is also what gives an object weight.
Weight	A measurement of the force of gravity between an object and the surface it stands on. If a person stands on a scale, gravity pulls the person against the scale. The scale shows the strength of this force, or the person's weight. Weight is the force of gravity. It acts in a downward direction—toward the center of the Earth.
Lift	The force that acts at a right angle to the direction of motion through the air. Lift is created by differences in air pressure.
Thrust	The force that propels a flying machine in the direction of motion. Engines produce thrust.
Drag	The force that acts opposite to the direction of motion. Drag is caused by friction and differences in air pressure.
Potential Energy	Potential energy is the stored energy an object has because of its position or state. A bicycle on top of a hill, a book held over your head, and a stretched spring all have potential energy.
Kinetic Energy	The energy of motion. When potential energy is used it is converted into kinetic energy. You can think of potential energy as kinetic energy waiting to happen.
Catapult	A machine used to forcefully propel stones, spears, or other projectiles.
The Bernoulli Principle	An increase in the speed of moving air or a flowing fluid is accompanied by a decrease in the air or fluid's pressure.
Newton's Third Law of Motion	For every action, there is an equal and opposite reaction.

Pre and Post-Materials for Students

You will be provided the following materials:

Post-Materials

- **Challenge Worksheet** on developing your own catapults and paper planes

Formal Outline

- Initial Instructor Introduction (2 minutes)
- Tour of USS *Hornet's* Flight Deck (5 minutes)
- Active Instruction with PowerPoint visual aid (25 minutes)
 - Four Forces of Flight
 - Bernoulli's Principle
 - Newton's Third Law of Motion
 - The similarities and differences of a Land Runway in relation to a Flight Deck Runway
 - Development of Technology to all safe takeoff
 - The USS Hornet Instructor will conduct demonstrations of:
 - Bernoulli's Principle
 - Newton's Third Law of Motion
 - Paper Airplane Launch without and with catapult
- The USS Hornet Instructor will conduct a question/answer period (5 minutes)
- Conclusion
 - Thank all for attending and review the Challenge Worksheet