

Duration: 90 minutes

MATERIALS

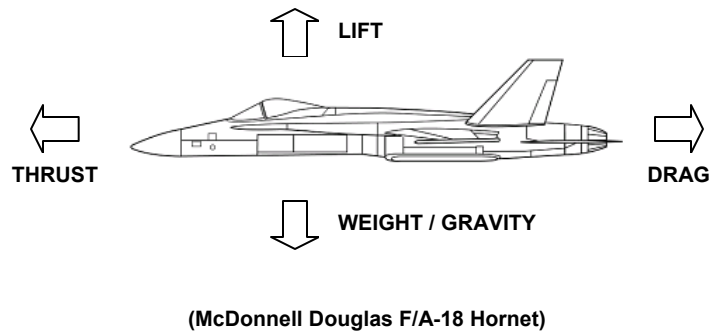
Skipping ropes
Construction paper
Markers, pencil crayons
Magazines / Newspapers for cut-outs
Internet access, LCD projector or SMART Board
Student access to computer with Internet access

RESOURCES

How Stuff Works: [The Wright Brothers: The Four Forces of Flight](#)
[Blueprint For Life/Work Designs – The Quick Reference Guide](#)

INSTRUCTIONAL METHODS

Demonstration
Direct Instruction / Lecture
Brainstorming
Independent / Cooperative Learning



LESSON OBJECTIVES

- ✓ Students will understand how the community, the economy and technological advances impact work and work roles (BP 6.2)
- ✓ Students will understand the role of a Mechanical Engineer in reducing drag in devices that fly
- ✓ Students will be able to provide examples of how science and technology have been used to solve problems related to drag in devices that fly (Physical Science – Flight FL 6.2)
- ✓ Students will demonstrate an understanding of the relationship between drag and fuel consumption in devices that fly

BACKGROUND INFORMATION

Do you like to know how things work? Do you have a knack for math and science, enjoy problem solving, work well as part of a team? Well then, you've got the makings of an engineer or geoscientist. The many careers available in engineering and geoscience give you the opportunity to shape your future according to your interests and play a role in shaping the future of the world.

Mechanical engineering is a type of engineering that is concerned with designing machines that make our society function. You could be designing the next generation of automobiles, aircraft, artificial hearts, or space-age materials.

MOTIVATIONAL SET

Review with the students the four forces (thrust, drag, lift, and weight / gravity) that act on living things or devices that fly through the air (from Physical Science – Flight FL 6.1.2). All things that fly need to overcome, or take into account, these forces when considering flight. Tell the students that today they are going to be mechanical engineers, researching new ways to decrease drag in devices that fly.

PROCEDURE / TIMELINE

I. Demonstration (10 minutes)

Teacher will have students experience the concept of drag for themselves. This can be done in the hallway, classroom, or gym.

1. Students will be put into groups of three.
2. Each group will be given a skipping rope or piece of rope.
3. One student will carry the rope (at waist level) from a pre-determined point (point A) to another pre-determined point (point B). This will be an example of no forces, no drag.
4. The student will then carry the rope from point A to point B while one student provides resistance from behind them holding the rope and they will try to go from point to point. This demonstrates drag as the resistance prevents the student from moving forward.
5. This may be repeated with two students holding the rope and providing more resistance this time.

Key Questions: Why is it harder to move when a student or two is holding you back? *(Because they are providing resistance, a force against your path of travel, known as drag.)*

What makes it easier to move? *(No resistance, no drag.)*

What else could make it easier if you could not remove the other students? *(Change the flooring that you are on → on ice would be easier. Change the student's footwear → being on rollerblades, or sock feet versus running shoes would be easier.)*

II. Video (2 minutes)

Show the following two minute film from "How Stuff Works" entitled "The Wright Brothers: The Four Forces of Flight". It demonstrates the four forces of flight that occur on an airplane and provides a quick review of the concept of drag.

<http://videos.howstuffworks.com/hsw/17997-the-wright-brothers-the-four-forces-of-flight-video.htm>

III. Direct Instruction (5 minutes)

1. Definition of drag: *Drag is the aerodynamic force that opposes a flying object's motion through the air.*
2. Introduce the means by which drag can be increased or decreased. By decreasing drag, the fuel consumption of an airplane is also decreased. *Drag can be increased or decreased by:*
 - i. *changing shape*
 - ii. *changing surface area*
 - iii. *changing surface type*

-
3. Inform students that drag is not always a detrimental force. It can be useful.

Key Question: How can drag be useful? (*Drag is useful in instances such as for parachutes and airplane landing.*)

However, drag is not desirable for efficient flight.

IV. Brainstorming (8 minutes)

1. Brainstorm some ideas beforehand to get students thinking about shape, size, and materials that might improve negative effects of drag. Teacher may have to begin and lead the students through the brainstorming activity to prompt and promote ideas. Use simple ideas drawn from the demonstration activity prior but transform the train of thought to airplanes.

Examples: Size of airplane → *less drag on something big and bulky or small and compact?*

Shape of airplane → *less drag on something with lots of projections (things sticking out) or compact and less projections?*

Materials → *less drag on a rough surface or a smooth surface?*

2. Students will then be instructed to research/investigate/find ways that science and technology have helped in overcoming the problem related to drag in devices that fly, more specifically, aircrafts in this lesson.

V. Independent Learning or Cooperative Learning (60 minutes)

1. Provide students or groups of students with these potential research areas for advancements in science and technology that have contributed to reducing drag for a class presentation or research paper to hand in.

OR

2. Teacher can lead a whole class discussion going through a few of the following examples to show students these advancements using a PowerPoint slideshow or a simple previewing of the websites for each topic (websites available for download from the APEGS website www.apegs.sk.ca, click 'About Us', 'Youth Programs'.), and then have them extend their learning by researching and handing in a pamphlet made to showcase one of the following examples.

A. Undulating skin

B. Retractable landing gear

C. Airfoils

D. Slotted wings and flaps

E. Swept wings

F. Horten Flying Wing

G. Changing from Biplanes to Monoplanes

H. Fairings

I. The Northrop Flying Wing

J. Wing surface coatings

DEBRIEF

1. In this lesson students will have learned the concept of drag and how it affects devices that fly. They will be able to provide some examples of how science and technology has been used to solve the problem of drag in devices that fly.
2. Throughout this lesson, students will delve into the mind of the mechanical engineer. They will have learned about the way in which technological advances allow continuous improvement in the efficiency of machines.

Key Questions: Do they understand the role of a mechanical engineer in solving drag-related problems? What exactly does the mechanical engineer do?

What subjects might a mechanical engineer need to be good at in order to be successful?

Would they consider a career in mechanical engineering?

3. Students will also gain the added understanding of how advances in technology impact the work and work roles of the engineer.

Key Questions: Have advances in science and technology made the job of a mechanical engineer better or worse? Why?

What do you think the future holds for the role of a mechanical engineer in today's world?

ASSESSMENT / INDICATORS

1. Depending on the decision the teacher makes to deliver this lesson, a simple rubric may be prepared ahead of time with the students to assess the group presentation on a drag-reducing advancement. Also, a simple rubric may be created to assess the product if the group will be handing in a research paper, or if they will be handing in a pamphlet.
2. Again, the indicators that the teacher will be looking for are an understanding by the students of the following items:
 - i. The students understand and are able to provide examples of how science and technology have been used to solve problems related to drag in devices that fly.
 - ii. The students realize the work that mechanical engineers do and how solving problems such as drag are related to this field of work.
 - iii. The students understand how technological advances impact work and work roles.

This lesson plan is available for download at www.apegs.sk.ca (click "About Us", "Youth Programs").