



Drexel-SDP GK-12 ACTIVITY

Science

Weather and Aeronautics

Up, Up and Away! Introduction to Aeronautics.



Grade Level _6_ (_5_-8_)

Lesson # _1_ of _10_

Lesson Dependency Lessons 1 through 10 of the Weather and Aeronautics Lesson and Activity Group

Time Required: 2 Hours

Summary

Using an aircraft model, instrumentation posters, charts, and pictures, introduce students to the aviation theme and to the basic parts of airplanes. We'll get into the vocabulary and the phraseology of aviation. Be careful not to reveal too much about controlling an airplane, as this will be covered in Lesson 4 via an inquiry-based wind-tunnel activity. We will also talk about the local airport, different types of airplanes (single, multi engine piston, jet engine, fixed gear and retractable gear airplanes). Show personal experiences, including the logbook, certificates, textbooks, and videos.

We then introduce the course as a unit of 10 or more lessons, including:

- Weather
 - Properties of Air
 - Density
 - Pressure
 - Air Takes Up Space and has Weight
 - Air as a Fluid: Sailboats and Airplanes
 - What Causes Weather?
 - Air as a Solvent: What is the Dew Point?
 - Basic Weather Causes: Unequal Heating of the Earth
 - Causes of Unequal Heating: Landforms
 - Cloud Formations and the Atmosphere
 - Thunderstorms and the Jet Stream
- Aeronautics
 - Air Pressure and Bernoulli's Principle
 - Putting it All Together: Sustaining Flight
 - History of Flight
 - Forces of Flight
 - Gliders
 - Hot Air Balloons
 - Controlling Flight
 - In the Cockpit
 - Testing the Model: Wind Tunnel
 - Navigation Then and Now

Engineering Connection

The aeronautics course is intended as a multi-disciplinary course in physics, math and history of aviation. Navigation, forces of flight, principles of flight, history of flight, and environmental factors (including weather and landforms) are specifically investigated. The core curricular items are emphasized, and aviation is considered an underlying theme. The intent is to provide grounding to the curriculum components learned in a typical K-12 school year. Aviation easily generates a lot of excitement among this age group, and as a result, measurable results are expected in these subjects.

Keywords

- Aeronautics
- Weather

- Aviation
- Flight
- Bernoulli's Principle
- Air
- Cloud Formations

PA Science Educational Standards

- 3.1.7A Explain the parts of a simple system and their relationship to each other.
- 3.1.7B Describe the use of models as an application of scientific or technological concepts.
- 3.2.7A Explain and apply scientific and technological knowledge.
- 3.2.7C Identify and use the elements of scientific inquiry to solve problems.
- 3.4.7C Identify and explain the principles of force and motion.
- 3.5.7C Describe basic elements of meteorology.
- 3.5.7D Explain the behavior and impact of the earth's water systems.

Pre-Requisite Knowledge

None

Learning Objectives

After this lesson, students should be able to:

- **Identify basic types of airplanes, including single engine land, multiengine land, jet, seaplane, and helicopter.**
- **Identify basic wing structures, including the monoplane and the biplane.**
- **Realize the team effort and career opportunities between weather specialists, air traffic controllers, and the flight crew throughout the duration of a flight.**
- **Identify and map the basic forces of flight to a simple force diagram, and explain the balance between them in flight.**
- **Explain the basic communications protocol for communication and navigation, including the military alphabet and Morse code.**

Introduction / Motivation

The purpose of this lesson is to introduce the topic and career opportunities of general aviation. Aviation is an engineering grounding for the math and science concepts that grade 5-8 students will learn in their normal curriculum. The introduction is thus a "show and tell" of the concepts to come, including weather, properties of air, history of flight, and modern aviation communications and navigation.

Lesson Background & Concepts for Teachers

Aviation is a beautifully simple concept that came from our knowledge of basic math and science principles. It is a hallmark example of an engineering application of math and science, whose history includes a rich lineup of engineers and scientists who struggled together with the concepts of aviation. The early Wright Brothers even sustained injuries while testing their aircraft, due to what they later realized was a serious error in their mathematical model. If you

were to test an aircraft like the Wright Brothers, where would you go? They chose Kitty Hawk, NC, a soft and forgiving beach.

But even after their first flight on (anybody?) December 17, 1903, aviation was somewhat limited. It is difficult, for example, to traverse the country without running into some kind of rainstorm or adverse weather conditions. Even clouds presented a danger as the primary navigation method of the day was ground sight – that is, looking at prominent landforms on the ground. Throughout aviation’s first hundred years, we have experienced breakthroughs in navigation and avionics technology. Airplanes can practically fly themselves, and we have gained the ability to fly in the clouds. We often take for granted that the jet airplane we sit in will take off and fly us quickly to our destination, miles from the ground.

Why do you think we fly so high, anyway? The answer has to do with the weather. One thing we know for sure about airplanes is that they fly on air. So it makes sense that the air around us dictates the rules in which we fly. And the weather dictates the rules under which the air abides. Have you ever heard of air pressure? Density? Dew point? What do these things mean? We will become mini-meteorologists in the weeks to come.

During this course, we will explore all of these engineering breakthroughs, from their early history to their modern day usage. We will also learn the science and math fundamentals that led to these modern inventions.

- **Basic Types of Airplanes and Wing Structures**

What do we already know about airplanes? (Make a list) One thing we will likely agree on is that airplanes come in many different forms. They include *monoplanes, biplanes, land planes, sea planes, gliders, helicopters, and hot air balloons*. They are so different that it seems surprising that they share flight concepts in common. We will learn how each of these stays in the air. Time permitting, one can google for images of each of the airplanes that the students suggest.

Using AOPA PATH pages 2-4, review the different parts of the airplane and go over what they do. Don’t go into too much detail as these will be covered in later lessons.

- **Basic Forces of Flight**

We will learn later what keeps these airplanes in the air. Using AOPA PATH page 5, review the basic forces of flight. Again, don’t go into too much detail, but it would be helpful to show that these forces counteract one another in a constant game of tug of war. If lift exceeds weight, the airplane climbs. If lift is smaller than weight, the opposite will happen. Relate the parts of the airplane to the forces of flight (propeller to thrust, wings to lift). Weight and drag are each generated by the load of the airplane and the airplane’s body. They are similar to friction generating heat when one rubs his or her hands together – it’s similar to burned energy.

Show students these concepts using a ruler – center of gravity is very important to hold the ruler up straight. Adding weight to the ruler causes one to need to balance the ruler in a different position. This is a good quick activity to prove the point.

- **Communications Protocols**

What about some of the more practical elements of flying? A lot of people are involved in the flights we take every day. We only ever see the flight attendants and ticket-takers, but some of the key players include the pilot, the flight crew that may assist the pilot (although some airplanes only require a single pilot), the air traffic controller who uses

radar to track airplanes and a radio to instruct the pilots to avoid conflicts in the air, and the weather specialists who brief the pilot on weather conditions and provide assistance for weather avoidance using weather radar. We've all talked on walkie talkies at some point in our lives (or even cell phones!) and they're not always very clear. Therefore, we have systems for efficient communications that stem from our war history. The military alphabet includes words for each letter of the alphabet. Spell some random names and words, or aircraft tail numbers which identify all airplanes. See the *November* at the beginning of aircraft tail numbers? That signifies that the aircraft was registered in the United States.

For purposes of navigation, it is important to ensure that the airplane is flying towards the correct navigation beacon (we'll learn about these later!). To do this, the navigation beacons broadcast a morse code identifier. For example, Lancaster, PA has a navigation beacon identified by the letters LNS. Those letters are broadcast over a VHF radio frequency continuously in morse code for identification by the pilot.

Vocabulary / Definitions

Word	Definition
Monoplane	An airplane with a single wing.
Biplane	An airplane with two wings, one on top of the other.
Airfoil	A structure capable of deflecting wind according to Bernoulli's Principle and Newton's Third Law, creating a flight condition.
Propeller	The part of the airplane that produces thrust. [From AOPA PATH]
Wing	The part of the airplane that produces lift. [From AOPA PATH]
Force	Acceleration applied to a mass.
Rotorcraft	An airplane with a moving propeller-like wing on top of the structure.
Glider	An airplane with no engine or propellers; this airplane uses rising air alone to produce lift.

Associated Activities

None

Lesson Closure

Conclude the lesson with a grab-bag of flight instruments, maps and equipment from the flight bag. A number of pictures can be found at <http://www.cs.drexel.edu/~wmm24/personal.html>.

Lesson Summary Assessment

Have students start a journal discussing their interests in aviation, and what they would like to learn about. Ask them to name some different kinds of airplanes, and to describe the "tug of war" between the forces of flight.

References

AOPA Path: Pilot's and Teacher's Handbook. <http://www.aopa.org/path/>.

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