Aviation Connections Integrated Unit

Working Draft
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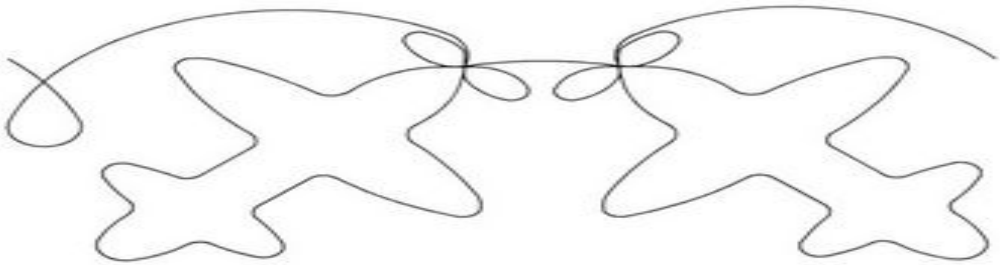

AVIATION CONNECTIONS: Integrated Unit

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  Guiding Question
  Essential Questions
- Pg. 3 History of Aviation
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Overview

Aviation Connections is an integrated unit for grades five through nine to provide strength for the transition years in academic concepts included in the Kentucky Program of Studies and Core Content 4.1. This interdisciplinary approach emphasizes the understanding of content knowledge and for application and includes instructional strategies for differentiation. All of the material can be taught as one unit, as modeled in the Aviation Institutes, or material specific to a content area could be taught as a separate unit.

This unit starts with student work by addressing the following content areas/standards with low CATS 2005 scores:

- **Applied Aerodynamics:** Objects moving in a three-dimensional space, four forces of flight (lift-weight-thrust-drag), Newton's Laws of Motion, three axes of flight, center of gravity, compositions and properties of air, and Bernoulli's Principle.
- **Map Skills/Basic Navigation:** How a compass works, map grids, map scales, terrain feature, how to determine distance on a map, finding points with a given azimuth, weather elements, space environments and our solar system.
- **Mathematical Applications**: Time-speed-distance calculations, chart interpretation, and weight/balance calculations.

Throughout the year, as you pilot this unit, student work will be collected and then you will have opportunities to work with other teachers to analyze the student work during the two Institute follow-up meetings. (KCTM/KSTA and KTLC) This will provide the depth of your students' conceptual understanding of content knowledge and its application. The reflection on student work will help to guide the refinement of the unit content and strategies.

As a working draft, you will find a column for "Classroom Notes". While teaching the unit this provides you with space for your comments and suggestions to help you and in the refinement of the unit.

A list of the contributors to the unit has been provided for you to contact for any assistance.

Guiding Question

What connections to Aviation are found when studying concepts in mathematics, science, social studies, and literacy?

Essential Questions

-How do the Laws of Motion relate to how an airplane flies?
-How does an airplane fly?
-How does a pilot using longitude and latitude know where to fly and where to land?
-In what way do linear equations connect to flying in an airplane?

aviation history

By Steve Parker

I. History of Aviation

Aviation Greats from Kentucky
(Careers, Social Studies, Science and Technology)

Aviation History Resources

History of Aviation Timeline

Aviation touches you everyday – packages, travel, and organs flown in…

Civil War: Hot Air Balloons

1956 – Round the World in 80 days movie, Jules Vern wrote book……movie…

1903 – 2003 100 yrs of flight flew 120 ft. 12 sec…….changed the world

Now - 777 first airliners built completely on computers

Consider satellite technology impacted your life – "satellite down, come inside to pay"

1911 – First coast to coast flight – 69 days – 16 crash landing

Classroom Notes:

Pg. ii: Wright Brother's Timeline

1914 – 1st scheduled passenger service – Tampa to St. Petersburg, FL - $5.00 - 19 min.

1918 - 1st Airmail service DC – NY

1924 – 1st around the world flight – 175 days

1927 – Charles Lindburg - 33 ½ miles – flew across the Atlantic

1928 – Amelia E – 1st woman to fly across Atlantic – died trying to fly around the world

1937 – Hindenburg blew up

1942 – 1947 - Spruce Goose Wooden Airplane by Howard Hughes – 1-mile flight

Aviation in KY
Tuskegee Airman - An American Story
Unblemished record

Strategic Air Command - commander from Somerset

One arm success story - from Paducah – Sherry Coin Marshall

Rosie the Riveter – from KY Pulaski County, left her children, assembled airplanes
She was the "face" of the war bond drive

Evelyn Johnson – Mama Bird – 57,000 flying hours – mid 90's – runs airport in TN
Certified flight instructor and she brings cookies

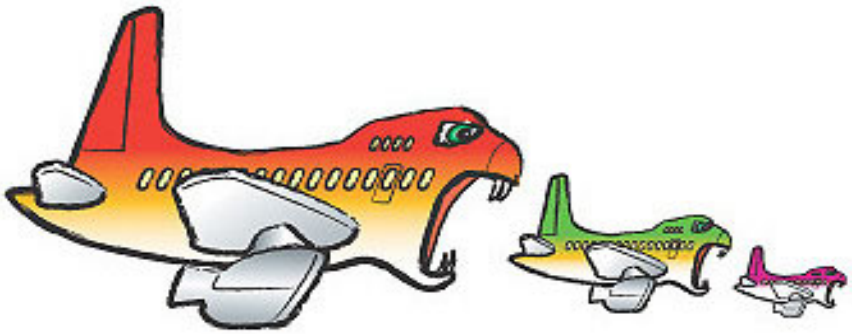
Classroom Notes:

Frances Gary Powers – U2 pilot shot down in Russia and held prisoner

John Paul Riddle- founder of Embry-Riddle University

Willa Brown Chappell- first African-American woman licensed as a pilot in the U.S.

Classroom Notes:



aerodynamics

By Sean Howard

Slide 1

What makes and airplane fly?

Unit One: Pg. 3, 15-16

Slide 2

Ingredients for Flight

- Bernoulli's Principle
- Newton's Laws of Motion
- Inertia
- Energy
- Velocity and Acceleration
- Three Dimensional Movement
- Stability and Controllability

Unit One: Pg. 7-13: Newton's Third Law

Slide 3

Atmospheric Properties

The atmosphere is a fluid and exhibits fluid properties.

Many of the principles of fluid dynamics apply
to the atmosphere.

- Bernoulli's principle
- Non-Compressibility

Unit Two: Bernoulli's Principle: Pg. 31, 44

Slide 4

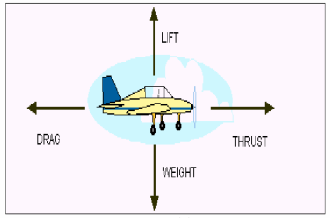
Parts of an Airplane

Activity

- Cockpit
- Fuselage-"Spindle Shaped"
- Wing
- Flap
- Aileron-"Little Wing"
- Empennage-"Feather the Arrow"
- Stabilizers
- Rudder
- Elevator
- Engine

Slide 5

Four Forces of Flight



Forces on an airplane

Unit One: Sled Kite: Pg. 6-13, 56, 65, 67, 69

Slide 6

Lift

- Lift is an aerodynamic force
- Lift must exceed weight for flight
- Generated by motion of aircraft through air
- Created by the effects of airflow past wing
- Aircraft lift acts through a single point called the *center of pressure*.

Unit One: Sled Kite: Pg. 6-13

Slide 7

Two Possible Explanations

- Bernoulli's Principle
- Newton's Third Law

- http://www.grc.nasa.gov/WWW/K-12/airplane/bernnew.html
- Aviation institute Teacher's Guide-Anderson & Eberhardt, *The Newtonian Description of Lift*

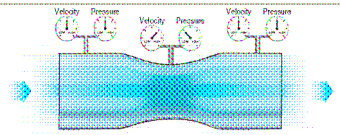
Unit Two: B.P.: Pg. 31, 44

Unit One: pg. 9, 12-13 Newton's Third Law

Slide 8

Bernoulli's Principal

Pressure Drop in Venturi Tube



Unit Two: Pg. 31, 44, 73

Slide 9

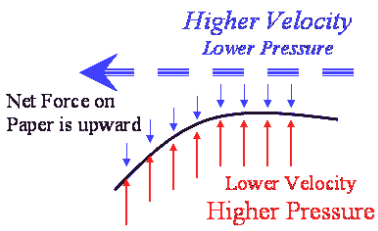
Bernoulli Every Day

- Garden Hose (Thumb or Nozzle)
- Perfume atomizer
- Chimney on a windy day
- Tornados often blow windows out
- Pumps
- Carburetors

Slide 10

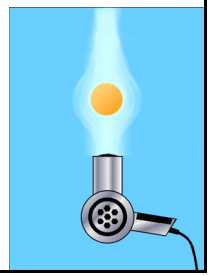
Bernoulli's Strip

Activity



Slide 11

Bernoulli Demonstration



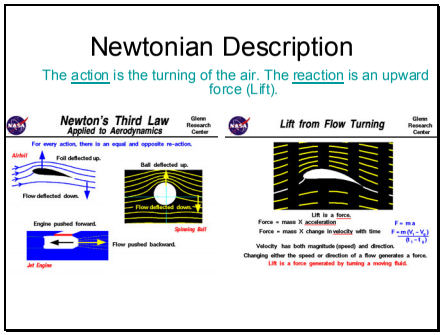
Slide 12

Newton's Third Law

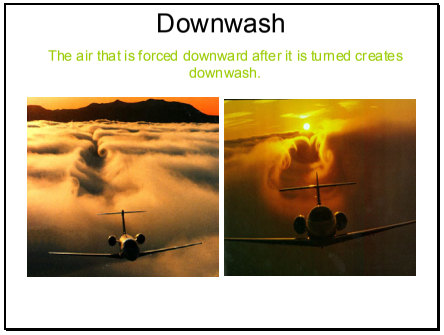
For every action there is an equal and opposite reaction.

Unit One: Pg. 9, 7-13, 22

Slide 13



Slide 14



Unit One: Test for lift: Pg. 11-12

Slide 15

So now what!

The air flowing across a wing is turned and deflected downward due to the shape of the wing. Applying Newton's third law, an equal and opposite force to the downwash is applied upward. This upward force is called Lift.

See "The Newtonian Description of Lift", Anderson & Eberhart

Slide 16

Factors that Affect Lift

Lift Equation: $L=C_L*.5r*A*V^2$

- C_L is a function of AOA
- R is air density
- A is wing area
- V is velocity or speed

Slide 17

NASA FoilSimE

Activity

Teacher Institute DVD

Use the Foilsim to show factors that affect lift.

Complete Characteristics of Wing & Lift Area Worksheet (NASA).

Slide 18

Inventing Flight

Video Clip

Unit 2 Introduction; Wings That Work

Slide 19

Weight

- Weight is not constant
  - Varies with passengers, cargo, fuel load
  - Decreases as fuel is consumed or payload off-loaded
- Direction is constant toward earth's center
- Acts through a single point called the center of gravity (the CG)

Unit Two: Canard Glider: Pg: 22, 64-67

Slide 20

Thrust

- Forward-acting force opposes drag
- Direction of thrust depends on design
- Propulsion systems produce thrust
- Equal to drag in straight, constant speed flight

Unit Twp: Canard Glider: Pg. 22

Unit Three: Pg. 80-83, 88- 89

Slide 21

Balloon on a String

Activity

Demonstrates Newton's Third Law and thrust.

CAP-Module 4, Page 11

Slide 22

Drag

- An aerodynamic force
- Resists forward motion
- Increases with the square of speed
- Two broad drag classifications
  - Parasite drag: drag created by airplane shape
    A result of air viscosity.
  - Induced drag: by-product of lift generation
    Caused by the wingtip vortices.

Unit Two: Pg 31, 68-70

Slide 23

Wingtip Vortex

Energy is lost during the formation of the vortex.

This energy loss is Induced Drag.

Slide 24

Wingtip Vortices

Slide 25

A parachute is a real Drag!

Activity

What type of drag is exhibited by a parachute?

Slide 26

Planes and Parachutes
Cirrus only one certified

Slide 27

Lets Build and Airplane!!

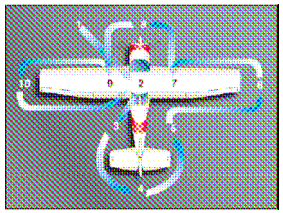
Activity

Assemble the Sky Streak included with the Inventing Flight module.

Inventing Flight DVD: Unit 2, Lesson 2-4a

Slide 28

Pre-Flight



Slide 29

Energy

Potential-Energy that is stored as a result
of position.
Kinetic-Energy in motion.

Inventing Flight Teacher Guide
Page 79

Unit Three: Pg. 85-92

Slide 30

What makes an airplane turn?

Slide 31

Newton's First Law

An object at rest tends to stay at rest and
an object in motion tends to stay in motion with the same speed and in the same direction unless acted upon by an
outside force.
The tendency of and object to resist a change in motion is Inertia.

Slide 32

Based on Newton's First Law: For an object to travel in a circular path, a force must be exerted on the object to turn it.

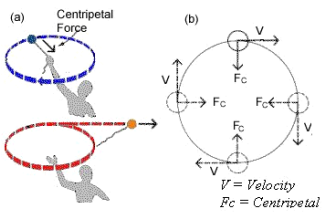
What is this force called?

Slide 33

Centripetal Force!

Slide 34

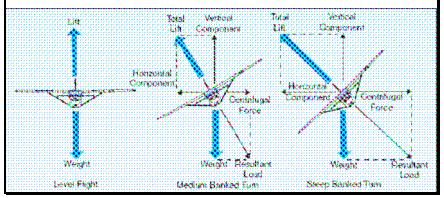
Ball on String



Slide 35

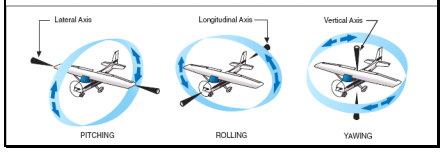
Horizontal Component of Lift

The Invisible String



Slide 36

Three Axes of Movement



Slide 37

If I were an Airplane

Activity

Stand up and move your body in three dimensions.

Slide 38

Three Axes

Activity

Soda Straw Demonstrator
CAP-Module 1, Page 17

Slide 39

Stability

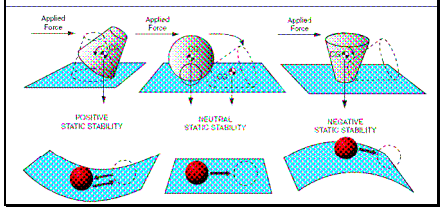
Two Types

- Static-The initial movement of an object after being disturbed.
- Dynamic-The behavior of the object over time.

Slide 40

Stability

Positive-Neutral-Negative



Slide 41

Salad Bowl and Ball

Activity

Demonstrate stability with clear bowl and ball
bearing.

Slide 42

Stabilized by Design

- Empennage (Longitudinal & Vertical)
- Dihedral (Lateral)
- Anhedral (Lateral)
- Incidence (Lateral)
- Yaw damper (Vertical)
- Keel Effect (Vertical & Lateral)

Pg. 16

Science Connections-Aerodynamics

NOTES

Bernoulli's Principle Activities:

Paper sack mask to demonstrate with Elem. Children
Slip of Paper blowing, hair dryer, extensions – MS, HS

1. Students teams label an airplane picture with only their own prior knowledge

Teams research parts of an airplane; label / check all parts

2. What Makes An Airplane Fly? Activity

3. WHAT ARE THE FORCES OF FLIGHT?

Forces of Flight Activity

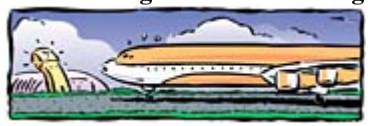
Students (1) Research, (2) Record, (3) Communicate,
(4) Develop Consensus for Four Forces and their definitions
(5) Create a list of several definitions and connections
(6) Identify questions students have

Review of Four Forces by Teacher

Inquiry Stage 3 - 4

Build a vehicle or aircraft powered by a balloon.

INQUIRY STAGE 3 - 4 – Have students use a variety of materials to build a vehicle powered by a balloon. (The purpose is develop an inquiry activity, student-directed, demonstration for * potential and kinetic energy, *affects of aerodynamic design on speed, *affects of gravity, friction, weight, acceleration on performance. This is a first draft. It might be a cumulating activity. Sue Ellis)



Classroom Notes:

Instructions
Using the materials provided, build a vehicle (transportation device, aircraft, powered by a balloon. Create data tables, measure distance, time and calculate the speed your vehicle. Change one design element at a time and measure the changes in your vehicles travel speed, time and distance. Prepare a written report of your design and its abilities and present to your classmates.

Have a large variety of materials laid out for student group use:

Cardboard
Styrofoam plates
Paper plates
Construction paper
Trash bags of various mil strengths
Butcher paper
Freezer paper
Wrapping paper
Aluminum foil
Wax paper
Shoe boxes
Small boxes of any type
Paper towels
Paper towel center cardboard rolls
Toilet paper center cardboard rolls
Straws
Nails
Screws
Bolts
Washers (small to larger)
Toothpicks
Wire of various tensile strengths
Pencils short and long
Pipe cleaners
Exacto knives
Scissors

Classroom Notes:

Dowell rods of various sizes and lengths
String of various sizes
Rope – small diameters only
Yarn
Thread - thicker types
Needles
Tape of various kinds and widths
Glue of various kinds and abilities
Solid soap bars
Other substances to reduce friction on wheels
Balloons of several sizes
Rubber bands of several sizes

Aerodynamics
Ingredients for Flight

WHAT MAKES AN AIRPLANE FLY?

5. INGREDIENTS FOR FLIGHT
Bernoulli's Principle
Newton's Laws of Motion
Inertia and Energy
Velocity and Acceleration
Fluid Dynamics
Three Dimensional Movements
Stability and Controllability

6. ATMOSPHERIC PROPERTIES
The atmosphere is a fluid and exhibits fluid properties

Many of the principles of fluid dynamics apply to the atmosphere.

Bernoulli's Principle Activity -
Use Paper sack mask to demonstrate with Elem. Children
Use thin strip of paper for Middle Levels

Classroom Notes:

Allow High School students to create their own demonstrations of Bernoulli's Principle

(1) Allow students to work in teams to label airplane by recording their prior knowledge on a picture.
(2) Have students research parts of an airplane in their teams and label checking to make sure they have all parts correctly labeled

7. STUDENT RESEARCH

Cockpit - Human machine interface - Crews of 1, 2, and 3
Fuselage – Streamline shape of the airplane
Wings - lift airplane into air
Aileron - wheel left right and you move ailerons – French for little wing
Produces roll – air forces wings up and down
Flaps – on wings allows airplane to fly at slower speeds and steeper angle to land – are used in critical phases of flight – like take off and landing – used to get plane to lift off at a slower speed and use less runway. Land at a lower speed and lower distance.
Elevators – pull back on yoke and makes airplane nose go up or down – changes pitch
Pull back trees get smaller and push trees get bigger – too much can cause a stall
Rudder – moves plane left to right
Stabilizer –
Empennage – tail section – the entire assembly of horizontal and vertical stabilizers

Classroom Notes:

8. FAA Certified – apply for a certain number and can get it, as long it has not been used
N + 5 numbers and letter
N58SEE

9. **FORCES OF FLIGHT**

WHAT ARE THE FORCES OF FLIGHT?
WHAT ARE THE FORCES THAT ALLOW AN AIRPLANE TO FLY?

Activity – allow students to work in teams to Research forces of flight – have each team write their forces and definitions on large card stock paper. All groups place their discoveries on the wall. As a large group organize the discoveries into "like" groups.

Create 4 columns and place various definitions of lift, weight, drag and thrust in these columns.

Agree as teacher and learners upon the forces
Record questions students still have

IMPORTANT TO FLIGHT – MUST MEMORIZE FOR CFI

10. FLYING LEVEL PLANE = LIFT = THRUST=DRAG=WEIGHT

CHANGE THESE ITEMS AND CHANGES MOVEMENT OF PLANE

Classroom Notes:

LIFT is an aerodynamic force, must exceed weight of airplane,
created by airflow over wing

11. ACTIVITY – MULTIPLE INTELLIGENCES – KINESTIC
DRAW Cross-section of an airfoil

12. How we fly Rules of Forces and Motion – ON AVIATION INSTITUTES DVD

13. LIFT
LIFT is an aerodynamic force
Must exceed weight for flight
Generated by motion of the wing through the air or motion of the air past with wing
Created by effects of the airflow past the wing
Aircraft lift acts through a single point called the center of pressure

If lift is enough – you can fly backwards in relative motion to the ground

Center of Pressure – acts as fulcrum – center of gravity

LIFT – TWO Explanations and has both things going on
Bernoulli's Principle

Newton's Third law – equal and opposite reaction

Angle of attack = AOA
Forces that Affect LIFT

Classroom Notes:

Lift equation
L= C * .5r*A * V2
C is a function of AOA
R is air density
A is wing area
V is velocity or speed

14. ACTIVTY - HAVE STUDENTS USE THE FOIL SIM TO SEE HOW THE WING SHAPE MUST BE CONFIGURED TO CREATE VARIOUS FLIGHT SITUATIONS
NASA FoilSim
Science Section of Notebook

15. FUTURE FLIGHT NOTATION - MORPHING

16. WEIGHT

Weight is not constant
- Fuel decrease as it is consumed as you fly.
- Varies with passengers, cargo
- ALL forces acting on airplane downward toward the earth.
- Acts through the center of gravity (CG)

Classroom Notes:

17. DRAG

An aerodynamic force
- Resists forward motion
- Increases with the square of the speed
- Two broad classifications
- Parasite drag is created by airplane shape, a result of viscosity.
- Induced drag – more lift you produce, more drag is created too

Wingtip vortex – looks like a tornado – takes energy away from the lift – this called induced drag

18. Resources
www.nasa.grc.gov/wwwkn -12airplane - GOOD Aviation resources – teacher guides

- -

19. ACTIVITY: KIT ZIP LOCK – Bag with Ping-pong ball to use with hair dryer - One inch piece of paper to hold to end of lip and blow to show it rise with air pressure

20. EXTENSTION QUESTION FOR THOUGHT: CAN YOU THINK OF SIMILAR DEMONSTRATIONS WITH DIFFERENT TOOLS?

Hair Dryer with Ping-pong ball
Shop Vac and use a basketball
Can also use a leaf blower

Classroom Notes:

21. VIDEOS – can be found on your AVIATION INSTITUTES DVD for NEWTON'S LAWS critical to understanding how airplanes fly United Streaming has these videos and others free

1st law – An object at rest stays at rest until another force acts on it AND an object in motion stays in motion and in the same direction, until acted upon by another force (inertia). Friction act on objects.

2nd – The acceleration of an object is directly proportional to the magnitude of the force and inversely proportional to the mass of the object.
FORCE = MASS x ACCELERATION (REMEMBER AIR HAS MASS AND IT IS ACCELERATING)

3RD – ACTION REACTION FORCES - For every action there is an equal and opposite reaction.

22. BASIC AERONAUTICS – ACTIVITY: KIT
Balloon on a string – string, fishing line, straw on fishing line, blow up a balloon, tape balloon to straw, DEMONSTRATES THRUST, 3rd LAW for Aviation and for Aerospace and rocketry

Classroom Notes:

ENERGY
POTENTIAL ENERGY – energy at rest
KINETICS ENERGY – energy in motion

23. **ACTIVITY**
Energy Activity – INVENTING FLIGHT KIT

Take out Inventing Flight Teacher Guide – page 79

Rubber band powered airplane – wind up propeller and Potential Energy and Kinetic Energy

Stage 2 Inquiry Activity
Create a data chart for the entire class. Measure and record the distance each airplane flies with a variety number of turns of the rubber band (building potential using kinetic energy to fly the plane). Determine the average of the class. The multiple trials of multiple airplanes makes a more scientifically valid investigation to determine the distance these airplanes can fly with a various number of rubber band turns.

23. ACTIVITY: BUILD A KITE (PAGE 10 OF INVENTING FLIGHT ACTIVITY BOOK)
(1300 -)
Zip Locks – orange pre-cut kite, paper and washer bag
Store kites in poster tubes, or paper towels tube
Students can Build kite via instructions or teacher to use for demo only
Core Content use for building kites…Newton's 3rd Law of Motion, understanding lift, gravity, thrust, friction, inertia

Classroom Notes:

Names of items are in book:
Dowel rods are spires
String is flight line

Test Pilots – test flight

Refer to Program of Studies

24. ACTIVITY:SODA STRAW GLIDER
(Ping-pong ball zip lock)
Inventing Flight, Page 14
Inventing Flight DVD, Unit I, Lesson 1 – 2

25.ACTIVITY: LIFT Build an Airplane

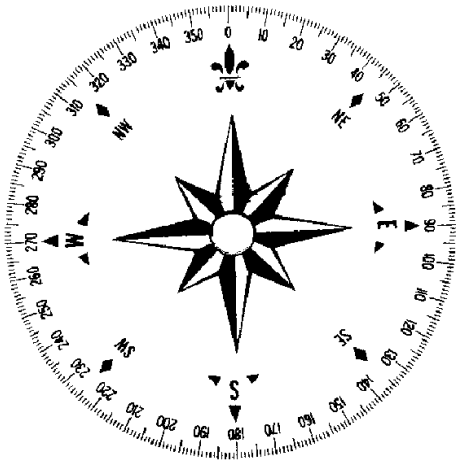
Factors that Affect Lift

26. ACTIVITY: Stage 3/4 Inquiry
Have students use the materials above to build, test, collect and summarize data about how their own airplane designs fly.

Classroom Notes:

social studies connections navigation

By Bill Schneider



Aviation Academy

Navigation and Planning

Tools of the Trade
Using Maps
Measuring the Numbers
Calculating the Rest of the Data
Finding Your Way

Line of Position

Where Am I?

Coordinate Systems

One Dimension
Two Dimensions
Three Dimensions

Distances

Use the plotter and divider as means to determine and measure distances for flight planning.

Directions

Use the magnetic compass, the E-6B circular slide rule, and the plotter to determine and measure directions for flight planning. Recognize the differences between True Headings and Magnetic Headings.

Speed

Understand the differences between True Airspeed and Ground Speed. Use the E-6B to calculate basic speeds, based on time and distance.

Wind Factors

Recognize and calculate the impact of the wind on your speed and direction.

Writing the Plan

Create a database of information that will aid in completing the flight.

Navigation Methods

Recognize characteristics of a range of navigation methods to include: map reading, radar, radio signals, electromagnetic waves, and celestial bodies. Describe how each can create a LOP for navigation.

Navigation with a Compass

Navigation with a Global Positioning System

SOCIAL STUDIES CONNECTIONS: NAVIGATION

NOTES

1. Tools of the trade
Using maps
Measuring the numbers
Calculating the rest of the Data
Finding Your Way

2. NAVIGATION OVERVIEW / REVIEW

PLAN A TRIP
Distance measured in nautical mile (nm)
Use latitude as your scale
One minute of latitude equals one nm
Measure along longitude line

Speed is measured in knots (nm/hr)
True airspeed is what the pilot reads
The wind will determine your ground (GS)

Direction - measured in degrees
0degrees (360 degrees) is North
East is 090 degrees
180 degrees is South
West is 270 degrees

Use a line of longitude to measure direction
Gives your true heading (TH)

Classroom Notes:

References True North (North Pole)

Pilot reads Magnetic Heading (MH) from Compass
Referenced to Magnetic North
Use Variations on the map to convert to True Heading

Aviators = pilots and navigators

East is Least and West is Best

AKA Whiz Wheel

3. ACTIVITY

TAKE OUT YOUR AERONAUTICAL CHART

1. WRITE YOUR AERONAUTICAL CHART FOR YOUR HOME
2. ROUND TO NEAREST WHOLE MINUTE OF LATITUDE AND LONGITUDE

4. NAVIGATION METHODS

<u>MATH Concepts</u>

Map reading – Dead reckoning – if you read it wrong you're dead
Know your general location – know where you SHOULD be – double check
Find very recognizable landmarks
Verify before correcting your heading

Direction from a radio station and Distance from a radio station
Radio frequency is on aeronautical map
Azimuth – line of position (LOP) from instruments on panel (DOR) tunes in radio frequency
Pilots use these cardinal positions for direction (NSEW) and directions to two radios stations (intersection of two radio lines)

Classroom Notes:

VORTAC – Distance from a radio station –
Variable Omni Range Tactical Air Navigation

5. RADAR MAPPING

Via signals by speed of light - knowing time and speed - we can get distance

Land will reflect BUT water MAY NOT reflect so screen will show a rough picture

To do radar mapping I want something CLEARLY DEFINED. Never take a curve – take a point. A way to determine a line of position.

6. CELESTIAL NAVIGATION

good for nighttime navigation

Polaris – North Star
Provides direction to True North
Provides your latitude - measure angle from horizon

7. GPS – GLOBAL POSITIONING SYSTEM

Array of Satellites

Incorporates signals of several to determine
Latitude
Longitude
Altitude

Accuracy in feet

Classroom Notes:

Use Sextant for other stars, planets, sun and moon.
Gives your latitude when checking angle to True North

8. Activity 1 – Using Circular Slide Rule – Plan a trip
Mapquest Plan from Piner
Complete distance Column of plan
Write down the planned speed
Calculate the time for each "leg"
Starting with the time for each "leg"
Starting with the time you plan to leave, fill in your ETAs for each point
Work backwards to calculate the time remaining
Spreadsheet model

9. PLOTTER and DIVIDER

Nautical Mile	vs.	Statue Mile
6076.1 ft.		5280 ft.

Based on the length of one minute arc of latitude

Great Circle vs. Rhumb Line

Equator is a Great Circle. It is the only latitude great circle. The International Date Line and all lines of longitude are great circles. Anything that cuts the earth exactly in half. There are an INFINITE Number of great lines on a globe BECAUSE each line of longitude is a Great Circle.

Rhumb Line is a spiral from the Top around so that it intersects each line of longitude at exactly the same angle. Allows making a map on a flat circle.

Use the plotter and divider as a means to determine and measure distance for flight planning.

Classroom Notes:

Activity 2
Map Quest map to Hazard
Discuss lines of position (1 dimension)
Find the following town and describe them in terms of map features
Lexington….where I-75 crosses I-64

Winchester

Jackson

Louisa

Krypton

Campton

Beattyville

Mt Sterling

10. ACTIVITY 3
Build a scale to use the Map to Hazard
Measure the distance (along I-75) from Crittenden to the I-64 interchange in inches
Look up the distance in miles on the Map Quest plan
Your scale is _____ miles per 1 inch (27)
Now measure the distance (inches) between Vancleve and Jackson
The scale times _____ is the distance.

Coordinate Systems
Latitude and longitude
These are critical to navigation
One, two or three dimensions

Classroom Notes:

Linear – one dimension – linear lines
- two dimension -
- three dimension – Cartesian coordinate system

One arc = one nautical mile

11. HOW DO WE MEASURE DIRECTIONS

AIR NAVIGATION
CONVERSION TO ACADEMIC MATHEMATICS

MAGNETIC NORTH POLE

N 78.3 degrees
W 104 degrees

Moves about 9 miles each year because of the metallic molten core of the Earth

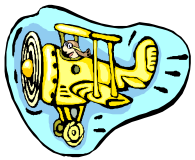
ACTIVITY 7 4:40
Each table is tasked to model the magnetic pole using an orange

MAPS (UNTIL - 5:10)

Classroom Notes:

math connections
linear relationships

By Tim Smith



Mathematics/Technology Connections

Rationale

- Standards-based
- Authentic problems and real world connections (TIMMS report)
- Collaboration
- Literacy connections (writing, mathematical, technical)
- Learning styles (especially the kinesthetic)
- Cognition/Depth of Knowledge
- Intense!

Mathematics Best Practices - NCTM

- ***Equity.*** Excellence in mathematics education requires equity—high expectations and strong support for all students.
- ***Curriculum.*** A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.
    - Rational numbers
    - Meaning of proportion*
    - Positive whole number exponents
    - Compute rational numbers
    - Apply ratios and proportional reasoning*
    - Order of operations
    - Basic geometric elements*
    - Two-dimensional shapes*
    - Similarity*
    - US customary and metric units of measure*
    - Estimate measurement*
    - Use formulas to find perimeter*
    - Determine the measure of angles*
    - Relationship between measurement formulas*
    - Relationship between proportional figures*
    - Meaning of dispersion

Classroom Notes:

FUN!

- Construct and interpret sets of data
- Issues with bias and faulty data collection*
- Variance
- Equations

- Wear out kids instead of teacher!
  - Rectangular coordinate systems
  - Solve simple equations
  - Linear Relationships (fuel consumption rates and rate of climb/descent)
  - Write and solve equations that represent everyday life*
- ***Teaching.*** Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.
- ***Learning.*** Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.
  - Student choices
  - Collaboration
  - Use of the world as their laboratory
  - Responsibility!
  - Teacher's role
  - Constructivist learning and exploration
- ***Assessment.*** Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.
- ***Technology.*** Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.

Unit of Study

- Duration 9 weeks
- Students assume role of Pilot/Aviator
- Phases

Classroom Notes:

- Ground School (DVD/other materials on physics of flight)
- Aerodynamics (Wind Tunnel Lab)
- Cross Country Flight Planning
- US Air Force Museum at Dayton
- Air Force Cadet Speaker
- Flight Simulator
- "Real" Flight from Capital City Airport

Technology Connections

- Graphing Calculators
- DVDs
- Internet Research (planning)
- Flight Simulation Software
- Technology is used as a tool to facilitate deeper learning of core content in mathematics and other disciplines.

Open-ended Response Question – Participants will experience this phenomenon on a simulator and then they will answer the question below using tools provided.

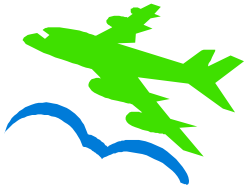
- You are the pilot of a Cessna 172. You have just taken off from the Capital City Airport in Frankfort, Kentucky. The best rate of climb for this airplane is 750 feet/minute. Your airport elevation is 841 feet.
    - Complete a table, graph, and state the equation for this relationship
    - How much time will it take for you to reach an altitude of 2000 feet, 5000 ft, and 10,000 feet? Use your graph, table or equation models. Explain your rationale.

Classroom Notes:

- What will your altitude be after 5 minutes? Use your graph, table or equation models. Explain.

Now that we have taken off, we will also work on landing the aircraft. There are some geometric and number calculations that must be taken into account in order to safely land the aircraft.

- Rectangular Pattern
  - Crosswind Heading
  - Downwind Heading
  - Base Heading
  - Final Heading



- Airport Diagrams – Participants will choose an airport and draw diagram including rectangular pattern.
- Flaps, Fuel, and 1000' agl (altitude)
- Wind Direction
- Crosswind Component
- Rate of Descent
- Practice Time (30 minutes)

Stations Example

Aviation Stations Graphic Organizer

Classroom Notes:

Station #1 – Wind Tunnel Lab Name _____

Examine the lift produced by two different wings. Answer the questions below.

1. How much lift is produced by the "flat" airfoil or wing? _____ grams
2. How much lift is produced by the "curved" airfoil or wing? _____ grams
3. How many times more lift is produced by the airfoil that had more lift? _____times

---

Station #2 – Aviation Navigation

In this station, you will be conducting some basic navigation using a sectional, angle rulers, and a ruler. Please answer the questions below to complete this station.

1. Find Capital City Airport located in Frankfort. What is its location in proximity to Lexington? _____
2. What heading would you fly if you traveled from Frankfort to Bowman Field in Louisville? _____
3. How far is it from Frankfort to Bowman Field? _____ statute miles, _____ nautical miles

Classroom Notes:

4. How much time does it take for you to fly from Capital City Airport to Bowman Field? Remember: t = distance/rate and a Cessna 172 cruises at 115 knots per hour._____ minutes
5. Find Cynthiana's airport on the sectional.
    a. What is its name? _____
    b. 3 digit identifier? _____
    c. elevation? _____
    d. radio frequency? _____
    e. runway numbers? (www.airnav.com) _____

Station #3 – Private Pilot Written Test

Answer all of the questions that you know. Do your best. You will pass on to the flight plan when you score 100% on this exam. We will go over all of the answers tomorrow.

Station #4 – Flight Simulator

Rotate pilots every 3-4 minutes!

1. Take off from Capital City Airport (KFFT)
2. After climbing to 1500 ft MSL, turn to 030 degrees
3. After one minute, turn to 270 degrees while maintaining 2000 ft MSL
4. Switch Pilots
5. Climb to 2500 feet
6. Turn to heading of 180 degrees
7. Turn to heading of 180 degrees
8. Switch pilots after 3 minutes
9. Fly at 2500 feet MSL and do some turns while maintaining altitude.
10. After 10 minutes, try to find FFT and land at the airport

---

Station #5 – Watch the Video, "Taking Off"

Classroom Notes:

What would it feel for you to be in the controls and actually take off in an airplane?

Classroom Notes:

MATHEMATICS CONNECTIONS: LINEAR RELATIONSHIPS

NOTES

1. How does your paycheck relate to linear relationships?
   How would car racing relate to linear relationships?
2. See graphic organizer in Math Connections…
3. **Accessing Prior Knowledge**

WORD WALL TO CHART RESPONSES
(Top choices: change, correlation, slope, and relationship)
Direct relationships
Slope - steep - rate time
Bank track to keep cars from falling over
Rise / Run
Direct correlation
Position relative to each other
Change in time produces change in income
Ordered pair

4. **Application Phase**

Bring Flight Sim Up

Rate of Climb Indicator - Keep it at 500 ft/ min – Constant as possible

Altimeter – measures altitude – big hand reads hundreds, little hand reads thousands

Classroom Notes:

5. MAKE: See mathematics section
(1) Table Model – collect data by timing and reading altitude at one-minute intervals

X (min)	0	1	2	3	4	5
Y (ft)	1250	1900	2300	2850	3300	3900

(2) Graph Model – independent and dependent variables
X - time
Y – altitude depends upon how much time you fly Altitude is changing increasing up

(3) Equation Model
y –intercept = 1250 = b
y = mx + b

500x + 1250 = y

6. KNOWING YOU KNOW
Write a one-sentence definition of linear relationship.

7. Benefits to Math Connections Brainstorm
Covers lots of content
Builds cooperative skills - collaboration
Authentic problems and Real world connections (TIMSS report)
Motivational strategies
Got a lot of math for not a lot of work
Integrated with content areas
Good pace
Technology connection
Literacy in math – one sentence – 7 guesses – word walls
Literacy – writing, mathematical, technical
OER – in your book
Grade levels vary
Relates to core content and standards

Learner centered
Learning cycle / style esp. Kinesthetic)

Classroom Notes:

Rigor and relevance – 4th column of depth of knowledge with this learning
Cognition (analysis, synthesis, evaluation)
Intense
Fun
Wear kids out instead of teacher

Rocket scientists
Engineers
Algebraic ideas
Teaching and learning
Student centered model
Student choices
Collaboration
Use of the world as their laboratory
Responsibility
Teacher's role
Constructivist learning and exploration

Assessment – should support the learning of important
Rubrics
Ways to assess whether they got it
Scoring guide
Checklist – know where you want them to go – students
Have to get there

8. Word Wall Aeronautics – Mathematics
Slope
Intersecting
Axis
Coordinate plane
Horizontal
Vertical
Degrees
Parallelogram
Rectangles

Squares
Digit

Classroom Notes:

literary connections

By Alice Noble

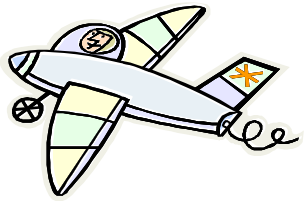
Literary Connections

Mercedes and the Chocolate Pilot
Institute Handout- found in notebook

Follow the Drinking Gourd
Institute Handout- found in notebook

Classroom Notes:

Resources



*Mouton's Impossible Dream by Anik McGrory

The story of the first flight in a balloon as told by the animals.

*Hot-Air Henry by Mary Calhoun A sassy Siamese cat stows away on a hot-air balloon and ends up taking a fur-raising flight across the mountains.

Stella Luna by Janell Cannon
After she falls into a bird's nest, Stella Luna--a baby bat--is raised as a bird until she's reunited with her mother.

*Grandpa Takes Me to the Moon by Timothy R. Gaffney
A child whose grandfather was an astronaut always asks Grandpa for the same bedtime story in which the two of them share an Apollo mission to the moon.

*The Glorious Flight by Alice and Martin Provensen
The story of Louis Bleriot whose fascination with flying machines produced the Bleriot XI, in which he crossed the English Channel in 37 minutes in 1909.

*Ruth Law Thrills a Nation by Don Brown
Plucky Ruth Law, wearing four suits for warmth, in 1916

Classroom Notes:

piloted her Curtis biplane from Chicago to New York breaking all U.S. nonstop flight records.

*One Giant Leap by Don Brown

The Story of Neil Armstrong.

*Jackal's Flying Lesson by Verna Aardema
After tricking Mrs. Dove into giving him her children, mischievous Jackal gets a flying lesson he'll never forget from a wise Crane in this retelling of an African folktale.

*Wings on Things by Marc Brown
Wings! Wings! Wings! What they are, what they do, and where they're found. Written in rhyme, this is a "Bright and Early Book for Beginning Readers."

*Plane Song by Diane Siebert
The excitement of flight is captured in poetry and paintings. Zooming across the pages of this book are stunt planes, spy planes, jumbo jets, bombers, and crop dusters.

The Wind by Monique Felix
A story without words in which a clever mouse transforms a sheet of paper into a flying machine.

*The Emperor and the Kite by Jane Yolen
The Emperor's youngest daughter--so small she went unnoticed--proves braver than anyone in the kingdom as she sets off to rescue her father with her kite.

Classroom Notes:

The Red Balloon by A. Lamorisse
The charming story of Pascal who is befriended by a magic balloon that follows him through Paris. Based on still photographs from the classic film of the same name.

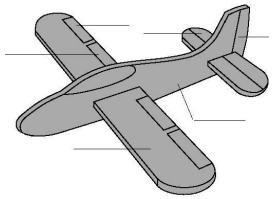
The Return of Freddy LeGrand by Jon Agee
After crashing into their barn, Freddy tells his rescuers Sophie and Albert about the wonders of flight.

Regards to the Man in the Moon by Ezra Jack Keats
With the help of his imagination, his parents, and a few scraps of junk, Louie and his friends travel through space.

Abuela by Arthur Dorros
Flying over New York City, gliding low to race sailboats in the harbor, Rosalba and her grandmother, her abuela, take an extraordinary trip--on Rosalba's imagination.

Tar Beach by Faith Ringold
Cassie Louise Lightfoot has a dream: to be free to go wherever she wants. One night, up on "Tar Beach"--the roof of her apartment house--the stars lift her up and she flies over the city.

Lindbergh by Chris L. Demerest
As a young boy, Charles Lindbergh dreamed of almost nothing but flying. Story covers his childhood and the experiences that prepared him for his successful flight across the Atlantic in 1927.



Classroom Notes:

AVIATORS

Amelia, Fred Wehr Using goggles that mysteriously appear on her seventh birthday, Cookie flies in some of her father's model airplanes and meets Amelia Earhart. ISBN 1-877853-35-X

Amelia's Fantastic Flight, Rose Bursik A young girl named Amelia builds her own plane and flies around the world, "freezing in Finland," "charmed by China," and getting a "kick out of Kenya"--before returning home for dinner. ISBN 0-8050-1872-7

The First Air Voyage in the United States, Alexander Waller Recounts the first air voyage of French aeronaut Jean-Paul Blanchard by hot-air balloon from Philadelphia to Woodbury, New Jersey in 1793. ISBN 0-8234-1224-5

Grandpa Is a Flyer, Sanna Anderson Baker Anne's grandfather tells how he became interested in flying in the early days of flight when barnstorming was popular. ISBN 0-8075-3033-6

I Am a Pilot, Cynthia Benjamin Anna and Josh soar into the sky on a big jetliner and dream about what it would be like to fly the plane. ISBN 0-8120-6407-0

Lindbergh, Chris L. Demarest From the time he was 8 years old, Charles Lindbergh dreamed of almost nothing but flying. This book covers his childhood in Wisconsin and the experiences that prepared him for his successful flight across the Atlantic in 1927. ISBN 0-5175-58718-1

*Young Amelia Earhart: A Dream to Fly, Susan Alcott An easy-to-read biography of the childhood of Amelia Earhart and

Classroom Notes:

how she became the first woman to fly across the Atlantic. ISBN 0-8167-2529-2

*Wilbur and Orville Wright: The Flight to Adventure, Louis Sabin Focuses on the childhood and youth of Orville and Wilbur Wright and their inventiveness even at an early age. ISBN 0-89375-857-3

FLIGHT

Abuela, Arthur Dorros Flying over New York City, gliding low to race sailboats in the harbor, Rosalba and her grandmother, her abuela, take an extraordinary trip--on Rosalba's imagination. ISBN 0-525-44750-4

Anatole Over Paris, Eve Titus Adventurous Anatole and his mouse family sail above Paris on a giant kite, but Anatole must figure out a way to get their paws back on the ground. ISBN 0-553-35240-7

First Flight, David McPhail A naughty teddy bear, in contrast with his well-behaved owner, ignores all the rules and disrupts their first airplane trip. ISBN 0-316-56332-3

Classroom Notes:

Flight, Donald Lopez, ed. Covers insect, bird, and animal flight and provides a historic/scientific background of flight from the Wright Flyer to flights of tomorrow. Glossary and colorful illustrations. ISBN 0-7835-4761-7

Let's Fly from A to Z, Doug Magee and Robert Newman An alphabet book of color photographs that familiarize young readers with parts of an airplane and those who work in aviation careers. ISBN 0-525-05105-5

Rainy Day Dream, Michael Chesworth In this wordless book, a boy gripping the handle of his umbrella is swept by his imagination into the air, where he sails over mountains, fields, and lakes, and busy harbors, reaching home just as the sun comes out. ISBN 0-374-36177-0

Tar Beach, Faith Ringold Cassie Louise Lightfoot has a dream: to be free to go wherever she wants. One night, up on "Tar Beach"--the roof of her apartment house--the stars lift her up and she flies over the city. ISBN 0-517-58030-6

The Wing Shop, Elvira Woodruff After his family moves to a new house, Matthew tries to return to his new neighborhood by trying on pairs of wings from a curious Wing Shop. ISBN 0-8234-0825-6

Classroom Notes:

FLYING ANIMALS

Bear's Bargain, Frank AschBear and his friend Little Bird try to help each other achieve impossible ambitions. ISBN 0-671-67838-8

Birds, Patricia Lantier-Sampon A colorful presentation of various birds in rhyming text. ISBN 0-8368-0541-0

Dragonfly, Emery Bernhard A simple natural history of a remarkable flying insect, the dragonfly, with beautiful illustrations and a glossary. ISBN 0-8234-1033-1

Eagles: Lions of the Sky, Emery Bernhard The national bird of the United States-- the eagle-- is the king of birds. Exploring their flight and other aspects of eagle behavior, the book shows how eagles and humans can share the environment peacefully. ISBN 0-8234-1105-2

Fly By Night, June Crebbin "Is it time Yet?" asks Blink the owlet. Not yet, he is told. Impatient, Blink endures the long day. Then the sun slips beneath the fields and the stars shine, and Blink takes his first flight. ISBN 1-56402-149-1

Flying Animals, Patricia Lantier-Sampon A rhyming introduction to animal flight from pterosaurs to bats and squirrels; contains a glossary. ISBN 0-8368-0540-2

Flying Insects, Patricia Lantier-Sampon Rhyming text accompanies colorful illustrations of familiar insects. ISBN 0-8368-0542-9

Classroom Notes:

Jackal's Flying Lesson, Verna Aardema After tricking Mrs. Dove into giving him her children, mischievous Jackal gets a flying lesson he'll never forget from a wise Crane in this retelling of an African folktale. ISBN 0-679-85813-X

In the Air and Everywhere Jody Marshall Everything you want to know about bird flight, with pop-up pictures of birds in their natural environment. ISBN 0-7167-6547-0

Ladybug Emery Bernhard A colorful introduction to the ladybug and the folklore associated with this familiar insect; includes colorful illustrations and a glossary. ISBN 0-8234-0986-4

Stella Luna, Janell Cannon After she falls into a bird's nest, Stella Luna--a baby bat--is raised as a bird until she's reunited with her mother. ISBN 15-280217-7

FLYING MACHINES

The Airplane Book, Billy and his family visit an airport to watch the planes and have a tour of Uncle James's jumbo jet as it sits on the runway. ISBN 0-307-68860-7

Classroom Notes:

Airplanes, Patricia Lantier-Sampon A compilation of various aircraft in verse; contains a glossary. ISBN 0-8368-0539-9

Airplanes and Flying Machines, Gallemard Jennesse Describes all sorts of planes and balloons. With unique acetate overlays to show side and inside views. ISBN-0-590-45267-3

Airplanes and Things That Fly. From birds and balloons to helicopters and jumbo jets, space probes, and the Space Shuttle, this introduction to things that fly is accessible to early readers. ISBN 0-307-11807-X

All Aboard Airplanes, Frank Evans Traces the development of aviation from the Wright Brothers to the Space Shuttle, describing how each plane/spacecraft is used. ISBN 0-448-40214

The Big Balloon Race, Eleanor, Coerr Ariel almost causes her famous mother, Carlotta Meyers, to lose her balloon race, but then helps her win it. ISBN 0-06-44053-2.

Planes, Angela Royston Photographs of light aircraft, passenger plane, biplane, fighter plane, seaplane, helicopter, glider, and the Concorde, with close-up views of specific parts. ISBN-0-689-71564-1

See How It Works: Planes, Tony PotterSee-through pages allow young flight fans to peer inside an airplane and to learn the names of all its parts. ISBN 0-689-71304-5

Classroom Notes:

What's Inside? Planes, Hilary Hockman, ed. Describes the internal and external workings of such craft as an airship, a helicopter, a jumbo jet, and an ultralight plane. ISBN-1-56458-135-7

FORCES OF FLIGHT

How Do Airplanes Fly, Isaac Asimov and Eliabeth Kaplan Briefly describes how the forces of lift and thrust are used to overcome gravity and friction to enable airplanes to fly. ISBN 0-8368-0800-2

The Wind, Monique Felix A story without words in which a clever mouse transforms a sheet of paper into a flying machine. ISBN-1-56189-095-2

The Wind Blew, Pat Hutchins The wind blew and blew! It blew so hard it took everything with it, but just when the wind was about to carry everything out to sea, it changed its mind! ISBN0-689-71744-X

Regards to the Man in the Moon, Ezra Jack Keats With the help of his imagination, his parents, and a few scraps of junk, Louie and his friends travel through space.

Classroom Notes:

If You Were an Astronaut, Dinah L. Moche Photographs of Astronauts at work and play during Shuttle missions with descriptive text. ISBN 0-307-11896-7

REFERENCE

Ardley, Neil. Dictionary of Science. NYC: Dorling Kindersley. 1995. 192pp. $20. ISBN 1-56458-349-X. YA-GA. Q123 .A73 1994

Organized by physical science themes including flight and technology; with short definitions and many diagrams and illustrations.

Baker, David. Flight and Flying: A Chronology. NYC: Facts on File. 1993. $65.00. Illus. index. ISBN 0-8160-1854-5. TL515 .B23 1994

Comprehensive coverage for facts, statistics, and related events for historic aviators and inventors; commercial and military aircraft; aircraft manufacturers; and specifications for all aircraft listed.

Berk, William and Frank Berk. Guide to Airport Airplanes. Plymouth, MI: Plymouth Press. 1993. 160pp. $13. ISBN 1-882663-00-4. TL512 .B47 1993

Classroom Notes:

Facilitates rapid identification of airport airplanes by amateur observers.

Hall, R. J. and R.D. Campbell. Dictionary of Aviation. Chicago: St. James Press. 1991. 346pp. $45.00 ISBN 1-55862-106-7. TL509 .H25 1991

Brief definitions of aviation and aerospace terminology, with a separate listing of abbreviations and acronyms.

Jennings, Terry J. Planes, Gliders, Helicopters, and Other Flying Machines. NYC: Larousse Kingfisher Books. 1995. Illus. 40pp. 1st American Edition. $6.95 ISBN 1-85697-869-9. TL547 .J445 1993

Examines how various types of airplanes and other flying machines work and what they do. Includes instructions for projects and experiments that teach flight concepts.

Parker, Steve. What's Inside Airplanes? NYC: Peter Bedrick Books. 1993. 44pp. $17. Elem-JH. ISBN 0-87226-394-0. TL547 .P273 1995

Detailed visuals of aircraft parts with labels and explanatory text.

Smith, H.C. (Skip). Illustrated Guide to Aerodynamics. 2nd ed. Blue Ridge Summit, PA: TAB Books. 1992. 272pp. $20. ISBN 0-8306-3901-2. TL570 .556 1992

Classroom Notes:

Dispels myths about aerodynamics and explains in everyday language just how an airplane flies.

The Visual Dictionary of Flight. NYC: Dorling Kindersley. 1993. Illus. 64pp. $17. Int- Adult. ISBN 1-56458-101-2. TL547 .E85 1992

Allows visual access to the specialized vocabulary relating to flying machines and aviation technology.

Wood, Derek. Jane's World Aircraft Recognition Handbook. 4th ed. Alexandria, VA: Jane's Information Group, 1989. 598pp. Illus. index. $20. ISBN 0-7106-0587-0. TL671 .W66 1989

Primer for aircraft recognition. Visual characteristics are emphasized with minimal factual information provided for individual aircraft.

PRINCIPLES OF FLIGHT

Anderson, John A. Jr. Introduction to Flight. NYC: McGraw-Hill. 1989. 640pp. ISBN 0-07-001641-0.TL570 .A68 1989

Classroom Notes:

College-level text on aerodynamics, aircraft performance, stability and control, and other flight-related topics.

Ayers, Carter M. Pilots and Aviation. Minneapolis: Lerner. 1990. Illus. $10. 80pp. JH-SH. ISBN 0-825-1590-3. TL547 .A97 1990

Nuts-and-bolts guide for junior high and high school students interested in learning how to fly.

Ceruzzi, Paul E. Beyond the Limits: Flight Enters The Computer Age. Cambridge: MIT Press. 1989. Illus. $43. 200pp HS-Adult. ISBN 0-262-03143-4. TL553 C38 1989

Argues that many advances in aircraft design and operation since 1945 are the result of computing developments.

Lafferty, Peter. Force & Motion. NYC: Dorling Kindersley. 1992. Illus. $16. 63pp. Int.-Adult. ISBN 1-879431-85-8. QC73.4 .L34 1992

Explores the principles of force and motion, describing their application from ancient to modern times.

Lopez, Donald. Flight. Alexandria, VA: Time-Life. 1995. Illus. $15. 64pp. Int-JH. ISBN 0-7835-4761-7.TL 547 .F54 1995

How things fly facts and principles are woven through this richly illustrated book.

Classroom Notes:

Time-Life Staff. Flight. Alexandria: Time-Life. 1990. Illus. $26. 144pp. ISBN 0-8094-7850-1. TL546.7 .B69 1990

Principles and realities of aerodynamics in nature and aircraft.

Van Dyke, Milton. An Album of Fluid Motion. Stanford, A: Parabolic Press. 1982. $15. 175pp. ISBN 0-915760-02-9. TA357 .V35 1982

Amazing collection of black and white photographs demonstrating fluid motion concepts and patterns.

ANIMAL FLIGHT

Brackenburg, John. Insects in Flight. NYC: Sterling. 1992. $35. 192pp. SH-Adult. ISBN 0-7137-2301-7. QL496.7 .B73 1992

Stunning photographs of flying insects. Text details the flight mechanisms.

Rupp, Rebecca. Everything You Never Learned About Birds. Pownal, VT: Storey Communications. 1995. Illus. $15. 144pp. Int-Adult. ISBN 0-88266-345-3.QL676.2 .R87 1995

Classroom Notes:

Lore and legends, science and nature facts (including flight and aerodynamic principles), and hands-on projects.

LIGHTER THAN AIR VEHICLES

BLIMPS

Munro, Roxie. Blimps. NYC: Dutton. 1989. Illus. $13. 32pp. Int-JH. ISBN 0-525-44441-6.TL656.2 .M86 1989

Discusses construction, design, operation and uses of blimps and the feel of riding in one.

Tanaka, Shelly. The Disaster of the Hindenburg: The Last Flight of the Greatest Airship Ever Built. NY: Scholastic. 1993. Illus. $17. 64pp. Int-JH. ISBN 0-590-45750-0. TL659 .H5 T36 1993

Contains photographs, diagrams, paintings, and drawings of the ship and its passengers, as told from the perspective of a 16-year old passenger who perished.

BALLOONING

Bellville, Cheryl Walsh. Flying in Hot Air Balloon. Minneapolis: Carolrhoda. 1993. Illus. 48pp. $18. Elem-Int. ISBN 0-876147-50-3. GV762 .B45 1993

Classroom Notes:

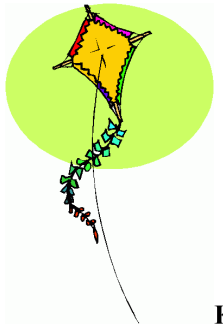
Photographs, aerial shots, and text show balloon enthusiasts at work and at play. Includes historical information.

Briggs, Carole S. Research Balloons: Exploring Hidden Worlds. Minneapolis: Lerner. 1988. Illus. 64pp. $22. Int-Adult. ISBN 0-8225-1585-7. TL631 .B75 1988

Discusses contributions that both manned and unmanned balloons have made to our understanding of the atmosphere, weather, air pollution, cosmic radiation, and the sun.

Fine, John Christopher. Free Spirits in the Sky. NYC: Atheneum. 1994. Illus. $15. 32pp. Elem-Int. ISBN 0-689-31705-0. GV762 .F56 1994

Balloon preparation, launch, flight, and landing are included, along with a section on worldwide festivals.



KITES

Michael, David. Jefferies, David. Making Kites. NYC: Larousse Kingfisher Chambers. 1993. 40pp. Illus. $7. Elem-JH. ISBN 1-856-979-229. TL759 .J44 1993

Classroom Notes:

Morgan, Paul & Helene. The Ultimate Kite Book. NYC: Simon & Schuster. 1992. Illus. 80pp. $20. ISBN 0-671-74443-7. TL759 .M66 1992

A catalog of the world's classic kites with instructions on how to fly them, along with patterns for making kites at home.

Rowlands, Jim. The Big Book of Kites. NYC: St. Martin's. 1988. Illus. 127pp. $15. JH-Adult. ISBN 0-312-02047-3. TL759 .R64 1988

After surveying modern kite styles, author describes kite-making materials and construction. Assembly instructions and problem solving techniques are given.

Schimmelpfenning, Wolfgang. Making and Flying Stunt Kites and One-Lines. NY: Sterling. 1993. Illus. 80pp. $20. SH-Adult. ISBN 0-8069-0870-X. TL759.6 .S78 S34 1995

Presents inspiring and practical advice, and technical instructions.

AIRCRAFT

Bellville, Cheryl Walsh. The Airplane Book. Minneapolis: Carolrhoda. 1991. $20. Illus. 48pp. Elem-JH. ISBN 0-87614-686-8. TL547 .B395 1991

Classroom Notes:

Brief overview of major advances in gliders, piston and jet engine planes, and helicopters.

Boyne, Walter, J. & Donald S. Lopez. Vertical Flight. Washington, DC: SI Press. 1984. 257pp. ISBN 0-87474-279-X. TL716 .V39 1984

Much of this is first-person accounts of helicopter pioneers; technical information found in text, photos and diagrams.

Goold, Ian. The Rutan Yoyager. Vero Beach, FL: Rourke Interprises. 1988. 32pp. $18. Int-Adult. ISBN 0-86592-869-x. G445 .G66 1988

Covers development and flight of the Voyager's nonstop trip around the world without refueling.

Johnstone, Michael. Airplanes. NYC: Dorling Kindersley. Illus. $6. 1994. 32pp. Elem-Int. ISBN 1-56458-520-4. TL547 .J575 1994

Ten planes in colorful, detailed, cross sections with clear labels and narrative text.

Kennedy, Gregory P., compiler. Rockets, Missiles, and Spacecraft of the National Air and Space Museum. Washington, DC: SI Press. 1983. Illus. $10. 164pp. ISBN 0-87474-571-3. TL506.U6 W376 1983

Highlights artifacts in the museum's collection with photos, history, and craft specifications.

Classroom Notes:

Parker, Steve. Flight and Flying Machines. NYC: Dorling Kindersley. 1990. Illus. 64pp. $13. Int-JH. ISBN 1-56458-236-1. TL547 .P27 1993

Brief look at the principles of flight through aircraft development.

Parker, Steve. Airplanes. Brookfield, CT:Millbrook Press. 1995. Illus. 32pp. $6. Int. ISBN 1-56294-946-2. TL547 .P268 1995

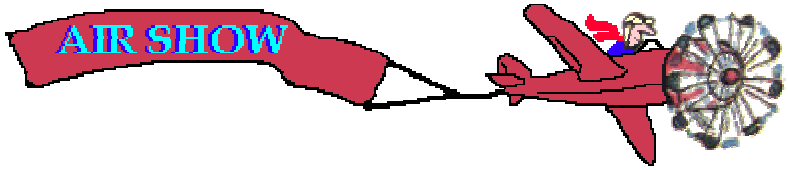
Imaginative look at flight and aircraft shown through simple questions and answers.

Parker, Steve. What's Inside Airplanes. NYC: Peter Bedrick. 1995. Illus. 44pp. $17. JH-Adult. ISBN 0-87226-394-0. TL547 .P273 1995

The parts inside airplanes and other flying machines and how they work.

Oakes, Claudia M. and Kathleen Brooks-Pazmany, compilers. Aircraft of the National Air and Space Museum. Washington, DC: SI Press. 1992. Illus. 180ppp. $10. ISBN 1-56098-153-9. TL506.U6 W376 1992

Highlights aircraft in the museum's collection with photos, history, and aircraft specifications.



Classroom Notes:

Sammon, Rick. 3-D Wings: Fabulous Flying Machines. Charlottesville, VA: Thomasson-Grant. 1995. Illus. 28pp. $12. Int-SH. ISBN 1-56566-087-0. TL547 .S32 1995

Photographs of famous flying machines take on a new perspective using the special 3-D glasses.

Siuru, Bill and John D. Busick. Future Flight: The Next Generation of Aircraft Technology. 2nd ed. NYC: McGraw-Hill. 1994. $20. 194pp. HS-Adult. ISBN 0-070-5777-8-1. TL671 .S565 1994

Advances in aircraft explored through aerodynamics, propulsion systems, materials, computers, and manufacturing techniques.

Van der Linden, F. Robert. The Boeing 247: The First Modern Airliner. Seattle: University of Washington Press. 1991. Illus. $25. 240pp. SH-Adult. ISBN 0-295-97094-4. TL686 .B65 V36 1991

Traces the origin and development of the 247 and briefly looks at those who were closely involved in the project.

Classroom Notes:

HISTORY & DEVELOPMENT OF FLIGHT

Berliner, Don. Before the Wright Brothers. Minneapolis: Lerner. 1990. $20. Illus. 72pp. Int-JH. ISBN 0-8225-1588-1. TL547 .B4179 1990

Tracks the evolution of successful human-controlled flight prior to the Wright brothers.

Berliner, Don. Distance Flights. Minneapolis: Lerner. 1990. Illus. 72pp. $22. Int-JH. ISBN 0-8225-1589-X. TL515 .B424 1990

The development of distance flying through trials and tribulations of flight pioneers.

Bilstein, Roger E. Flight in America: From the Wrights to the Astronauts. Rev. ed. Baltimore: Johns Hopkins University Press. 1994. $17. Illus. 386pp. SH-Adult. ISBN 0-8018-4827-X. TL521 .B528 1994

Historic look at significant events within aviation, aeronautics, and aerospace. Index to specific people, events, and aircraft.

Classroom Notes:

Boyne, Walter, Jr. The Smithsonian Book of Flight for Young People. NYC: Atheneum. 1988. 128pp. $17. Int-JH. ISBN 0-689-31422-1. TL547 .B685 1988

Comprehensive history of flight with the technical and scientific advances explained in understandable terms.

Briggs, Carole. At the Controls: Women in Aviation. Minneapolis: Lerner. 1990. $22. Illus. 72pp. Elem-JH. ISBN 0-8225-1593-8. TL547 .B74 1990

The history of modern aviation as seen through the achievements of female aviators.

Hardesty, Von, and Dominick Pisano. Black Wings: The American Black in Aviation. Washington, DC: SI Press, 1984. $11. ISBN 0-8747-4511-X. TL 553 .H34 1983

Photographs with captions recount the role blacks have played in shaping the growth of modern aviation.

Maurer, Richard. Rocket! How A Toy Launched the Space Age. NYC: Crown. 1995. $18. Illus. 64pp. Int-Adult. ISBN 0-517-59628-8. TL781.8 .U5 M3 1995

The historic developments of rockets, from ancient Chinese "fire arrows" up to the Saturn V.

Moser, Barry. Fly! A Brief History of Flight Illustrated. NYC: Harper-Collins. 1993. Illus. $16. 56pp. Int-Adult. ISBN 0-06022894-6. TL515 .M69 1993

Classroom Notes:

Short, episodic history of men and women and their flying machines along with a timeline of historic events on each page.

Scott, Phil. The Shoulders of Giants: A History of Human Flight to 1919. NYC: Addison-Wesley. 1995. Illus. $24. 304pp. JH-Adult. ISBN 0-201-62722-1. TL515 .S412 1995

Development of human flight, covering the period from antiquity to 1919.

The Story of Flight. NYC: Scholastic. 1995. Illus. 45pp. Int-SH. ISBN 0-590-47643-2.

Illustrations, unique foldouts, and overlays briefly explore flight and flight history.

Villard, Henry Serrano. Contact!: The Story of the Early Birds. Washington, DC: SI Press. 1987. Illus. $30. 260pp. SH-Adult. ISBN 0-87474-947-6. TL670.3 .V55 1987

Aviation history from 1905-1915, technology from the Wright brothers to World War I airplanes.

ACTIVITIES BOOKS

Blackburn, Ken, and Jeff Lammers. The World Record Paper Airplane Book. NYC: Workman. 1994. $15. Elem-Adult. ISBN 1-5630-5631-3. TL778 .B58 1994

Classroom Notes:

Beginners and experienced flyers alike learn to fold and fly 80 airplanes. Contains a landing strip and flight log.

Churchill, E. Richard. Fabulous Paper Airplanes. NYC: Sterling. 1991. Illus. 128pp. $15. Int-Adult. ISBN 0-8069-8342-6. TL778 .C48 1991

Begins with principles of flight followed by instructions for folding 29 simple to complicated airplanes.

Doherty, Paul, Don Rathjen, and Exploratorium Teacher Institute Staff. The Spinning Blackboard and Other Dynamic Experiments on Force and Motion (Exploratorium Science Snackbook Series). NYC: John Wiley. 1996. $11. ISBN 0-471-111-514-2. QC73 .D63 1996

Compilation of scientific exhibits housed at the Exploratorium, including instructions for assembly and explanations of the scientific principles involved.

Glover, David. Flying and Floating. NYC: Larousse Kingfisher Books. 1993. 32pp. Elem. $13. ISBN 1-85697-843-5. QC161.2 .G56 1993

Investigates the elemental properties of air and water through simple experiments.

Schmidt, Norman. Super Paper Airplanes: Biplanes to Space Planes. NY: Sterling. 1995. Illus. 96pp. $20. Int. ISBN 1-895569-30-3. TL778 .S364 199

Classroom Notes:

History of modern flight and development of 18 aircraft. Instructions for paper models of aircraft from gliders to supersonic transports.

Simon, Seymour. The Paper Airplane Book. NYC: Penguin. 1971. Illus. 48pp. $5. Elem-JH. ISBN 0-14-030925-X. TL770 .S4 1971

Experiments with models of paper airplanes show principles of flight and design.

Taylor, Beverly, James Poth, and Dwight Portman. Teaching Physics with Toys: Activities for Grades K-9. NYC: McGraw-Hill. 1996. Illus. $18. 296pp. ISBN 0-07-064721-6. QC39.5 .T39 1995

Learning chemistry and physics principles can be fun by using toys. Each activity contains background information.

Walker, Ormiston. Experimenting with Air and Flight. Danbury: Franklin Watts. 1989. $20. 76pp. JH-SH. ISBN 0-531-10670-5. TL547 .W24 1989

Demonstrates the forces of lift, thrust, drag and gravity as they apply to birds, airplanes, helicopters, balloons, and kites.

Classroom Notes:

CAREERS IN AVIATION

McKeeve, Michael, and Georganne Irvine. A Day in the Life of a Test Pilot. Mahwah, NJ: Troll Communications. 1991.Illus. $11. 32pp. Int-JH. ISBN 0-8167-2224-2. TL671.7 .M36 1990

Looks at the people who ensure the safety of aircraft and careers as test pilots.

Paradis, Adrian. Opportunities in Airline Careers. Lincolnwood, IL: NTC Publishing Group. 1989. Illus. 160pp. $14. JH-SH. ISBN 0-8442-6028-2. HE9803 .A4 P37 1987

Classroom Notes:

Resources

NASA Sites: http://www.NASA.gov/

1. Space Medicine
http://science.nasa.gov/headlines/y2002/30sept_spacemedicine.htm?list79629
Researchers discuss how to keep astronauts safe and healthy during long trips through the solar system.

2. Astro-Venture
http://astroventure.arc.nasa.gov
Astro-Venture is a guided inquiry-based, interactive, multimedia Website. Students in grades 5-8 role-play NASA careers as they search for and design a planet that would be habitable to humans. Students engage in online training modules to learn the factors that are required for human survival based on the observation of changes to the Earth. Students then engage in inquiry-based lessons that help them understand why these factors are necessary. Once students have a solid understanding of the "what's" and the "why's," they engage in another online multimedia mission in which they simulate "how" scientists would go about searching for a planet with these characteristics. Astro-Venture includes modules on Astronomy, Atmospheric Science, Geology and Biology and focuses on meeting standard-based concepts including: states of matter, basic chemistry, Earth's structure/processes, the flow of energy, conservation of matter and systems.

3. Beginners Guide to Aeronautics
http://www.grc.nasa.gov/WWW/K-12/airplane/
The Beginner's Guide to Aeronautics was created to provide background information on basic aerodynamics, propulsion, and model rockets. It was created to supplement for educators using FoilSim, EngineSim, or Model Rocket Sim and addresses national education standards.

4. EngineSim
http://www.grc.nasa.gov/WWW/K-12/EngineSim/
EngineSim is an educational interactive simulator that allows students to explore the effects of engine operation on total aircraft performance. The program works in two modes: Design Mode or Tunnel Test Mode. In the Design Mode, you can change design variables including the flight conditions, the engine size, the inlet performance, the turbo machinery compressor and turbine performance, the combustors or burner performance, or the nozzle performance. For a turbofan engine design you can also vary the fan performance and the bypass ratio. When you have a design that you like, you can switch to the Tunnel Test Mode which simulates the testing of a jet engine on a test stand. You can then vary the test altitude, flight speed and throttle setting. Several existing engines are also modeled in EngineSim.

5. FoilSim Software
http://www.grc.nasa.gov/WWW/K-12/FoilSim/
Foilsim is an interactive simulation software program that determines airflow around various shapes of airfoils. FoilSim computes the theoretical lift of a variety of airfoil shapes. The user can control the shape, size, and inclination of the airfoil and the atmospheric conditions in which the airfoil is flying. The program includes a stall model for the airfoil, a model of the Martian atmosphere, and the ability to specify a variety of fluids for lift comparisons. The program has graphical and numerical output, including an interactive probe which you can use to investigate the details of flow around an airfoil.

6. Re-living the Wright Way Website
http://wright.nasa.gov/
NASA has developed a Website and publication related to flight and the 100th anniversary of flight. The Re-living the Wright Way Website contains hands-on activities, a calendar of upcoming events with a NASA presence, archives of interactive Web casts/broadcasts, and background information on the Wright Brothers and their process of developing the airplane. There are links to current NASA research in aeronautics and interactive simulations of Wright Brothers discoveries, such as a wind tunnel, 3-D engine model, wing-warping, and animations of the control surfaces on the Wright Flyer.
The Website provides printable slides that can be used in the classroom, addressing various scientific, mathematical and aerodynamic principles.

7. Robin Whirlybird
http://rotored.arc.nasa.gov
Robin Whirlybird is an interactive, multimedia story for students in grades K-4. They learn about the structure, function and history of different types of rotorcraft in English, Mandarin and Spanish. The site includes inquiry-based lessons that engage students in the variables affecting rotorcraft flight.

8. WrightSim
http://wright.nasa.gov/
WrightSim is a realistic flight simulator that mimics the aerodynamics of the actual 1903 Wright Flyer. WrightSim was developed in support of the 100th anniversary of flight celebration and will involve students in the challenge of flying the world's first powered and controlled aircraft.