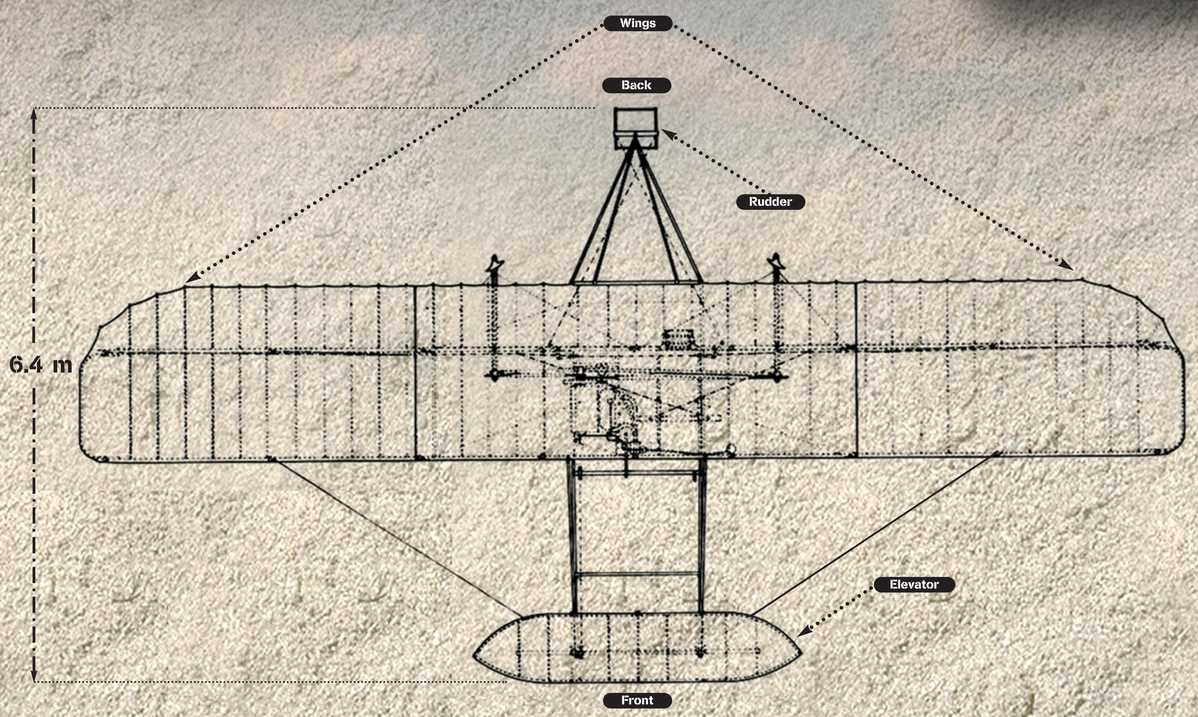
The Wright Way: Innovation Through Engineering

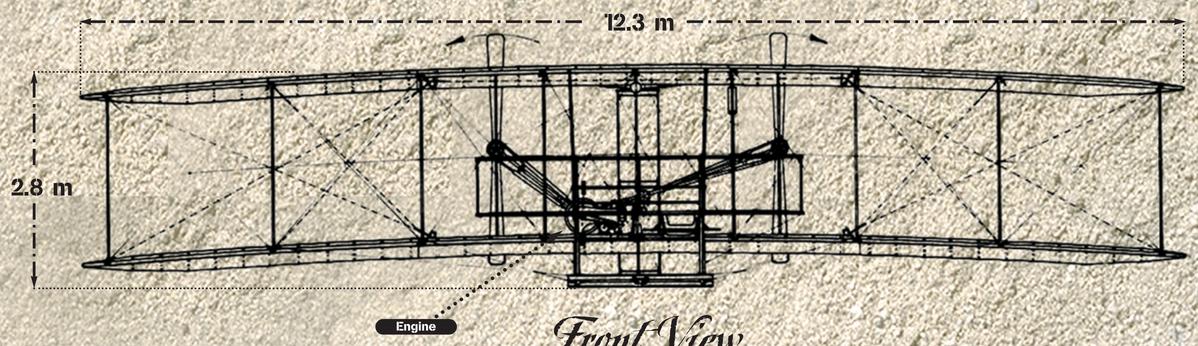
North Carolina—First in Flight

Orville Wright (1871-1948)

Wilbur Wright (1867-1912)



Top View



Front View

Wingspan, 12.3 m – Chord, 2 m
Overall Length, 6.4 m – Height, 2.8 m
Wing Droop, 25.4 cm
Weight, 229 Kg (without pilot).
Airspeed, 50 km per hour

Revolutions per min: Engine, 1025; propellers 325 (Reduction, about 3 to 1)

Pulley moved by wires from control lever shaft operated by pilot's left hand.

Wire Bracing

Bicycle hub rolled on monorail.

Sprocket on propeller shaft driven by chain from engine.

Gasoline Tank

Radiator

Elevator

Elevator Control Lever

Skids for landing. Instruments to record distance travelled, engine revolutions, and time while in the air.

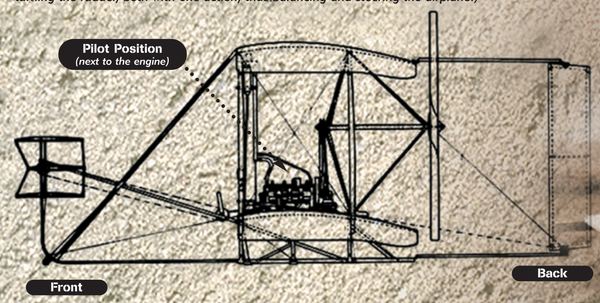
Rudder

Truck: A wooden beam, with "skate-like" rollers supported the airplane as it ran down the monorail during take-off. It was left behind as the airplane rose.

The rear edges of the wingtips were flexible and could be warped to maintain lateral balance.

Spruce Struts

Pilot lay prone with head forward, his left hand operating the elevator lever, his hips in a saddle. (Shifting the hips from side to side pulled the wires attached to the cradle, warping the wings and turning the rudder, both with one action; thus balancing and steering the airplane.)



Side View

100th Anniversary of Powered Flight

1903-2003

U.S. Department of Commerce Publication Q & A

Q: What is the metric system?
A: The metric system is a decimal-based system of measurement units.
All units are related by factors of 10.
Calculations within the metric system involve moving the decimal point to the right or left.

Q: Who uses the metric system?
A: Every country in the world except the United States, Liberia, and Myanmar (formerly Burma).

Q: Why doesn't the United States use the metric system as its primary measurement system?
A: Although many U.S. industries manufacture and label products in metric units, the inch/pound system is still the primary system of measurement in this country. The United States has not fully converted to the metric system possibly because many people think it's hard to learn and some U.S. companies think it would be too costly to begin manufacturing products using metric units. Canada and Australia converted to the metric system with little disruption in people's everyday lives.

Q: What U.S. industries are already using the metric system?
A: Automotive, pharmaceutical, medical and health care, computer, beverage, photography, science/technology (including meteorology and space), and engineering, among many others.

Q: Why should the United States convert to the metric system?
A: By using the metric system, U.S. companies will gain increased access to growing and expanding world markets and an increased ability to export. In addition, the Nation will benefit from eliminating inefficiency in business and daily life that is caused by the use of two different systems of measurement units.

Q: Hasn't there already been an effort to get the United States to convert to the metric system? Why wasn't this effort successful?
A: There have been several attempts to support a decimal-based measuring system in the United States. The most recent occurred in 1975 when Congress initiated the Metric Conversion Act in an effort to encourage U.S. businesses, governmental agencies, schools, etc., to use the metric system voluntarily. Although this act increased awareness and use of the metric system in the United States, most Americans were not convinced of the added benefits of converting and therefore continued using the traditional inch/pound system.

Q: What will make a current effort to promote the metric system successful?
A: There is now more incentive for the United States to convert to the metric system since all of the country's primary trading partners use it. By looking at the success of Australia and Canada's conversion to the metric system, it is possible for Americans to learn how these countries incorporated this system successfully and conveniently into their daily lives.

Q: Is conversion to the metric system costly?
A: Costs will vary in different sectors of the economy. However, in all areas, long-term benefits will be realized and will more than offset one-time conversion costs. Many industries are converting as they develop new products and as older equipment wears out.

Q: What are the advantages of using the metric system in the United States?
A: Not only is the metric system easy to use, it is the standard system of measurement throughout the world. Calculations can be conducted quickly and with fewer mistakes. It is also easy to convert between units within the metric system. By producing products that meet metric specifications, U.S. companies can improve their ability to compete in the global marketplace and increase exports. This not only means greater income for the United States but more jobs for American workers.

Q: What are the disadvantages of using the metric system in the United States?
A: Costs associated with converting to the metric system can be a problem in some industries. However, increased global trading and sales will offset one-time conversion costs. It is difficult to change the mind-set of Americans who are comfortable with the inch/pound system, although they do not realize they use the metric system every day with 35 mm film, two-liter bottles of soft drinks, and 500 mg tablets of aspirin.

Q: Is the metric system a European fad?
A: The metric system is used by more than 5 billion people and is the standard system of measurement throughout the world. It is highly compatible for use in complicated mathematical calculations and in computer programs.

Based on its history and use in technology, it looks as if the metric system is here to stay!

Q: Is the metric system hard to learn/use?
A: No, in fact, it is much simpler to use than the inch/pound system. The metric system eliminates the use of fractions since it operates in multiples of ten—this means that calculations can be completed by the simple movement of a decimal point. Also, since there are only seven basic units in the metric system (as opposed to 20 units in the inch/pound system), it avoids confusing dual use of terms such as the use of ounces to measure both weight and volume.

Q: Are children in the United States being taught the metric system in school?
A: Yes, many children are studying the metric system. By using the metric system in the classroom, schoolchildren can spend more time learning mathematics and science and less time understanding conversions among units in the inch/pound system and less time manipulating fractions.

Q: What is currently being done to promote the use of the metric system in the United States?
A: The Metric Program of the U.S. Department of Commerce's National Institute of Standards and Technology helps implement the national policy to establish the metric system as the preferred system of weights and measures for U.S. trade and commerce. It provides leadership and assistance on metric usage and conversion to Federal agencies, state and local governments, business, trade associations, standards organizations, and the educational community.

For more information and resources contact:

www.nist.gov
National Institute of Standards and Technology

1901–2001
NIST CENTENNIAL

The Celsius Poem

30 is hot,
20 is nice.
10 put a coat on,
0 is ice.

The NASA "Why?" Files
http://whyfiles.larc.nasa.gov

The NASA "Why?" Files series is a standards-based, technology focused, distance learning initiative designed to integrate and enhance the teaching of mathematics, science, and technology in grades 3-5. The series consists of four, 60-minute programs that use problem-based learning and scientific inquiry, including the scientific method and science process skills, to introduce students to the excitement and exploration of real-world mathematics, science, and technology.

The NASA "Why?" Files is video and Web-based, includes a resource-rich teacher guide, and is FREE to educators. The series combines the leading-edge technology of the Web with the content-driven, instructional quality of video programming. The user-friendly Web site engages students, teachers, and parents in the learning experience by linking them to a world of formal and informal learning opportunities that include NASA programs, projects, and researchers.

The presence of educational technology in the series mirrors the expanding application and integration of mathematics, science, and technology in the classroom.

Educators must register to receive the lesson guide. Register at the NASA "Why?" Files Web site: http://whyfiles.larc.nasa.gov

Celebrating a Century of Powered Flight

The Wright brothers turned their dreams into reality and revolutionized the world.

ABOUT THE POSTER

This poster was designed to honor the accomplishments of the Wright brothers, two brilliant, self-trained engineers from Ohio who designed, built, and flew the first power-driven, heavier-than-air machine in which humans made free, controlled, and sustained flight.

The historic event occurred on the morning of December 17, 1903, at a place known as Kill Devil Hills, four miles from the village of Kitty Hawk, North Carolina. At about 10:35 a.m., the Wright brothers' machine began to move down a rail into a frigid wind that was gusting up to 12 meters per second. The airplane rose and fell for 12 seconds until it struck the sand approximately 37 meters from where it had become airborne. For the first time in history, an airplane had taken off, moved forward under its own power, and landed at a point at least as high as that from which it had started—all under the complete control of the pilot. The photograph of the first flight, depicted on the front of this poster, was taken just as the Wright brothers' machine left the rail. The Wright brothers completed three additional flights that day, each farther than the one before.

The centennial of powered flight presents a unique opportunity to focus on the historical significance of the aviation-related events leading up to, and following, December 17, 1903. More importantly, the 100th anniversary of flight will inspire a new generation of inventors, innovators, and dreamers. In the span of a single century, the vision, persistence, and ingenuity of many have taken us from the first powered flight on the sand dunes of North Carolina's outer banks to a permanent presence in space.

In honor of the 100th anniversary of flight, the U.S. Congress established the U.S. Centennial of Flight Commission. The Commission will encourage, enable, and amplify the efforts of all the organizations and individuals planning to celebrate the achievements of the Wright brothers and a century of powered flight by serving as a catalyst for activities and a central resource. The Commission is encouraging and promoting national and international participation in the commemoration of the centennial of powered flight by the public; educators and students; Federal, state, and local government officials; members of civic and cultural organizations; and members of the aviation and aerospace industry.

We invite you to visit the U.S. Centennial of Flight Commission's Web site (**www.centennialofflight.gov**) where you will find information about the Commission, the centennial of powered flight, and the history of aviation and aerospace. The site has been designed to be used by educators and their students, aviators, aviation enthusiasts, the media, and all organizations planning to participate in the celebration. The Web site also includes a calendar that provides information about upcoming events related to the centennial of flight, the history of aviation and aerospace, and aviation in general. A "Submit an Event" feature is available for event planners who wish to post information on the U.S. Centennial of Flight Commission's calendar. New information and resources will be added regularly to the site through December 2003.

Measurement Standard, Pre-K–2

Understand measurable attributes of objects and the units, systems, and processes of measurement

Expectations:
- Recognize the attributes of length, volume, weight, area, and time
- Compare and order objects according to these attributes
- Understand how to measure using nonstandard and standard units
- Select an appropriate unit and tool for the attribute being measured

Apply appropriate techniques, tools, and formulas to determine measurements

Expectations:
- Measure with multiple copies of units of the same size, such as paper clips laid end-to-end
- Use repetition of a single unit to measure something larger than the unit, for instance, measuring the length of a room with a single meterstick
- Use tools to measure
- Develop common references for measurers to make comparisons and estimations

Implications/Emphases for the Classroom:
- Measuring devices need to be readily available for students
- Daily opportunities need to exist to use measurement tools
- Students need to understand what it means to measure
- Connections in spatial concepts and number concepts need to occur
- Direct comparison of objects by attributes, such as putting airplanes in order by length
- Emphasis on linear measurement
- Emphasis on finding relationships: "Can you find objects in the room that are 1 centimeter in length, 1 decimeter in length, and 1 meter in length?"
- Students need to build a rich vocabulary including words such as deep, large, long, length, height, etc.
- Cause and effect implication: "What if the unit of measure were twice the size? Would the length stay the same? Would the answer be the same? Why/why not?"
- Which measurement tool is appropriate to use and why?
- Movement from direct comparison of nonstandard to standard, to specific tools

Measurement Standard, Grades 3–5

Understand measurable attributes of objects and the units, systems, and processes of measurement

Expectations:
- Understand such attributes as length, area, weight, volume, and size of angles; select the appropriate type of unit for measuring each attribute
- Understand the need for measuring with standard units and become familiar with standard units in the customary and metric systems
- Carry out simple unit conversions, such as from centimeters to meters, within a system of measurement
- Understand that measurements are approximations and understand how differences in units affect precision
- Explore what happens to measurement of a two-dimensional shape, such as its perimeter and area when the shape is changed in some way

Apply appropriate techniques, tools, and formulas to determine measurements

Expectations:
- Develop strategies for estimating the perimeter, area, and volume of irregular shapes
- Select and apply appropriate standard units and tools to measure length, area, volume, weight, time, temperature, and the size of angles
- Select and use benchmarks to estimate measurements
- Develop, understand, and use formulas to find the area of rectangles and related triangles and parallelograms
- Develop strategies to determine the surface area and volume of rectangular solids

Implications/Emphases for the Classroom:
- Measurement tools need to be readily available
- Maps need to be readily available for use in determining distance and scale
- Measurement should serve as a connector to many areas of mathematics
- Vocabulary should include such words as area, volume, angle, perimeter, width, height, circumference, distance
- Reinforce mental images of customary and metric units by frequent reference to length, width, etc., of objects
- Establish benchmarks, such as a doorknob being a little less than a decimeter, and acute and obtuse angles being less than or more than a right angle
- Opportunities need to exist for students to see patterns to enable them to develop formulas for area and volume
- Students should witness change over time, such as their own growth, the growth of plants, or population shifts
- Opportunities need to exist for students to share, compare, and evaluate ideas

Measurement Standard, Grades 6–8

Understand measurable attributes of objects and the units, systems, and processes of measurement

Expectations:
- Understand both metric and customary systems of measurement
- Understand relationships among units and convert from one unit to another within the same system of measurement
- Understand, select, and use units of appropriate size and type to measure angles, perimeter, area, surface area, and volume

Apply appropriate techniques, tools, and formulas to determine measurements

Expectations:
- Use common benchmarks to select appropriate methods for estimating measurement
- Select and apply techniques and tools to accurately find length, area, volume, and angle measures to appropriate levels of precision
- Develop strategies to determine the surface area and volume of selected prisms, pyramids, and cylinders
- Solve problems involving scale factors using ratios and proportions
- Solve simple problems involving rates and derived measurements for such attributes as velocity and density

Implications/Emphases for the Classroom:
- Many opportunities should exist for students to use measuring devices daily
- Measurement should be connected to many areas of mathematics, especially geometry, algebra, and data analysis
- Rich vocabulary development should include: similarity, velocity, vertex, scaling, proportionality
- Opportunities must exist to examine relationships and patterns between shape and size, area and perimeter, volume and shape
- Skills in estimating and the use of benchmarks should be strengthened
- Opportunities must exist for students to compose, decompose, and recompose shapes to find volume, area, and surface area
- Opportunities must exist for students to discuss estimations, reasonableness of an answer, and accuracy of measurement
- Opportunities must exist for students to find patterns and relationships as they relate to length, area, volume, and perimeter
- Scale drawings, maps, and blueprints can be used to strengthen everyday connections to the classroom

Measurement Standard, Grades 9–12

Understand measurable attributes of objects and the units, systems, and processes of measurement

Expectation:
- Make decisions about units and scales that are appropriate for problem situations involving measurement

Apply appropriate techniques, tools, and formulas to determine measurements

Expectations:
- Analyze precision, accuracy, and approximate error in measurement situations
- Understand and use formulas for the area, surface area, and volume of geometric figures, including cones, spheres, and cylinders
- Apply informal concepts of successive approximation, upper and lower bounds, and limits in measurement situations
- Use unit analysis to check measurement computations

Implications/Emphases for the Classroom:
- Measurement connections should occur throughout high school in mathematics, technology, and science classes
- Students need opportunities in selecting which tools and units are best to use and why
- Opportunities should occur to allow students to make decisions with respect to efficient use of tools, data collecting, and reporting of data
- Students need to see methods and purposes of clear representation of data

References:

Principles and Standards for School Mathematics, *published by the National Council of School Mathematics, copyright 2000.*

A Little Metric Ditty

The thickness of a dime,
that is a millimeter.
So wide a thumbnail is,
shows us a centimeter.

An active 4-year-old,
the height of just one meter.
While sixty railroad cars,
stretch out a kilometer.

Dad's little fingernail,
squared centimeter shows,
and meter by a meter,
on a kitchen table goes.

Then do place side by side,
two U.S. football fields.
The size is rather big,
but hectare is the yield.

There are larger sizes still,
we won't go too much deeper.
10 hectares on each side,
square us a kilometer.

Going bigger or much smaller,
depending on one's need,
and everything that's squared,
can also cubic be.

Three-sided decimeter,
ten centimeters cubed,
is often called a liter,
when space inside is filled.

So fill it up with water,
cool from a mountain stream.
As heavy as a kilogram,
when on a scale is seen.

The cm cubed or ml,
a gram upon the scale.
A thousand kilograms,
the "metric" ton avail.

A system based on tens,
and now our poem is done.
So you can see that metric
can be a lot of fun!

NASA CONNECT
http://connect.larc.nasa.gov

NASA CONNECT is an Emmy award-winning series of 30-minute instructional distance learning programs designed to enhance the teaching of mathematics, science, and technology concepts in grades 5-8. Each NASA CONNECT program supports the national mathematics, science, and technology standards and is endorsed by the National Council of Teachers of Mathematics (NCTM).

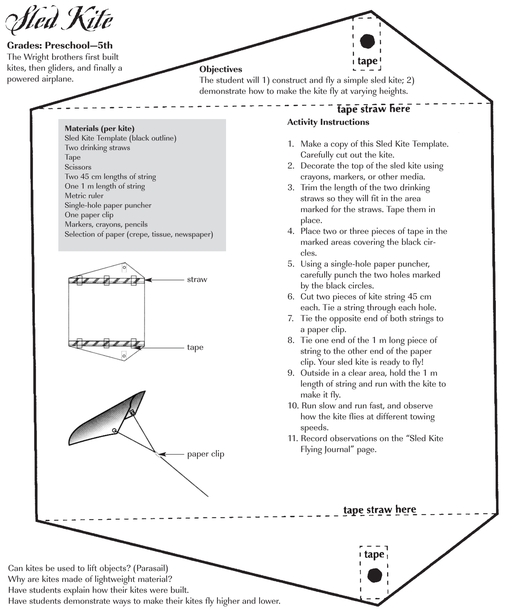
Each NASA CONNECT program seeks to establish a connection between the mathematics, science and technology concepts taught in the classroom and the mathematics, science, and technology used every day by NASA researchers. Each program is accompanied by a resource-rich educator's lesson guide, and uses a classroom activity and Web-based activity to complement and enhance the mathematics, science, and technology concepts presented in the program.

NASA CONNECT is FREE to educators and the programs in the series are in the public domain. Register for NASA CONNECT at http://connect.larc.nasa.gov

Sled Kite

Grades: Preschool—5th
The Wrights brothers first built kites, then gliders, and finally a powered airplane.

Objectives
The student will 1) construct and fly a simple sled kite; 2) demonstrate how to make the kite fly at varying heights.



Materials (per kite)
Sled Kite Template (black outline)
Two drinking straws
Tape
Scissors
Two 45 cm lengths of string
One 1 m length of string
Metric ruler
Single-hole paper puncher
One paper clip
Markers, crayons, pencils
Selection of paper (crepe, tissue, newspaper)

Activity Instructions

1. Make a copy of this Sled Kite Template. Carefully cut out the kite.
2. Decorate the top of the sled kite using crayons, markers, or other media.
3. Trim the length of the two drinking straws so they will fit in the area marked for the straws. Tape them in place.
4. Place two or three pieces of tape in the marked areas covering the black circles.
5. Using a single-hole paper puncher, carefully punch the two holes marked by the black circles.
6. Cut two pieces of kite string 45 cm each. Tie a string through each hole.
7. Tie the opposite end of both strings to a paper clip.
8. Tie one end of the 1 m long piece of string to the other end of the paper clip. Your sled kite is ready to fly!
9. Outside in a clear area, hold the 1 m length of string and run with the kite to make it fly.
10. Run slow and run fast, and observe how the kite flies at different towing speeds.
11. Record observations on the "Sled Kite Flying Journal" page.

Can kites be used to lift objects? (Parasail)
Why are kites made of lightweight material?
Have students explain how their kites were built.
Have students demonstrate ways to make their kites fly higher and lower.

From *Aeronautics: An Educator's Guide with Activities in Science, Mathematics, and Technology Education* EG-1998-09-105-HQ

Sled Kite Flying Journal

Date _____ Student Name _____

Weather _____

Sled Kite Flight
What happened when I walked with my sled kite?

_____

What happened when I ran with my sled kite?

_____

Sled Kite Tail
What if I add a tail to my sled kite? I think it will make my sled kite fly like this:

_____

After I added a tail to my sled kite, it flew like this:

_____

What if I shorten the tail? I think it will make my sled kite do this:

_____

After I shortened the tail on my sled kite, it flew like this:

_____

What if I lengthen the tail? I think it will make my sled kite do this:

_____

After I lengthened the tail on my sled kite, it flew like this:

_____

First Flights

Grades 6–12

Objective: Students will analyze and interpret data from the four flight trials of the Wright brothers on December 17, 1903, and use communication skills to write explanations of the events.

Activity A Procedure:
1. Use the data below and calculate the average speed of each flight trial.

Speed = Distance/Time			
Flight	Distance (meters)	Time (seconds)	Average Speed (m/sec)
1	37	12	
2	53	12	
3	61	15	
4	260	59	

2. Make a graph comparing the average speeds of the four trials. What factors might have influenced the flight of the plane and caused such different speeds?

3. Analyze the graph of "Speed vs. Time" below. Identify the events that occurred in sections A, B, and C of the graph. Write a paragraph about what happened during the flight.

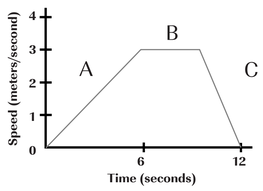
Extensions:
- The velocity of the wind at Kitty Hawk that day was up to 12 meters/second and the speed of the machine over the ground against the wind was 3.05 meters/second. What would have been the speed of the machine in calm air? How far would it have traveled during the first flight with calm winds?

- The flight speeds were not as constant as the data might indicate. Instead, there were control problems and erratic speeds. Find out how the Wright brothers solved these problems in later airplane designs.

- Depending on the experience of your students, use the graph "Speed vs. Time" as a model to create a graph that shows the changes in acceleration of the Wright Flyer during the flight.

The graph below represents a mathematical model of how the Wright brothers' first flight may have happened.

SPEED vs. TIME



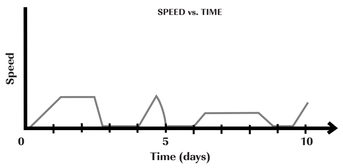
Activity B Procedure:

The Vin Fiz™ was a Wright brothers Model EX airplane built in response to a Hearst prize of $50,000 to be given to the first person to fly across the United States in 30 days.

Below is a "mathematical model" of the flight that took place in 1911 when pioneer aviator "Cal" Rodgers attempted a coast-to-coast 30 day journey in this Wright EX airplane. Unfortunately his flight took 49 days and was plagued by many problems, which included crashes when he collided with trees, chicken coops, and other obstacles. He replaced numerous parts of his plane during the 70 stops along the way, but managed to keep the Nation's interest focused on flying.

1. Using this "mathematical model" of "Cal" Rodgers' flight in the Vin Fiz™*, write a story about the first 10 days of Rodgers' trip. Research the various speeds of his plane, the events that took place between days 3, 4, and 5 and explain why the shapes of the "mathematical model" changed.
2. Present the story to the class using the "mathematical model" as a visual aid.
3. Create a graph of the entire flight.

SPEED vs. TIME



Extensions and Technology Connections:

Web sites:
Centennial of Flight
www.centennialofflight.gov
Wright Flyer Online
www.quest.arc.nasa.gov/services/lessons.html#wright
Newton's Second Law and Airplane Problems
www.grc.nasa.gov/WWW/K-12/BGA/Sheri/newton's_second_law_act.htm
Basic Airplane Balance—The Wright Brothers Bicycle Test
www.grc.nasa.gov/WWW/K-12/Missions/Rhonna/wright.htm
Beginner's Guide to Aerodynamics
www.grc.nasa.gov/WWW/K-12/airplane/bga.html
X-Gliders: Exploring Flight Research with Experimental Gliders
http://spaceflink.nasa.gov/products/X.Gliders/

Video:
NASA CONNECT: "Measurement of All Things: Tools of the Aeronautics Trade" (Grades 5-8)
NASA CONNECT: "Geometry and Algebra: Glow with the Flow" (Grades 5-8)

*TM 2000 Vin Fiz is a registered trademark of Inventing Flight: Dayton 2003.

Length Area Volume

A distance five toes wide,
shows 100 millimeters.
That's centimeters ten,
or else one decimeter.

In two directions go,
and square a decimeter.
Same distance on each side,
squares 100 centimeters.

For three directions see,
a cubic decimeter.
Since cubic they now be,
a thousand centimeters.

Three sided decimeter,
one can also liter name.
So a cubic centimeter,
see as milliliter same.

A cubic decimeter,
now with water fill the can.
And on a scale to see,
so pick up a kilogram.

Our tale of width, then area,
through mass and volume flows.
And cubic centimeter thus,
the gram so heavy shows.

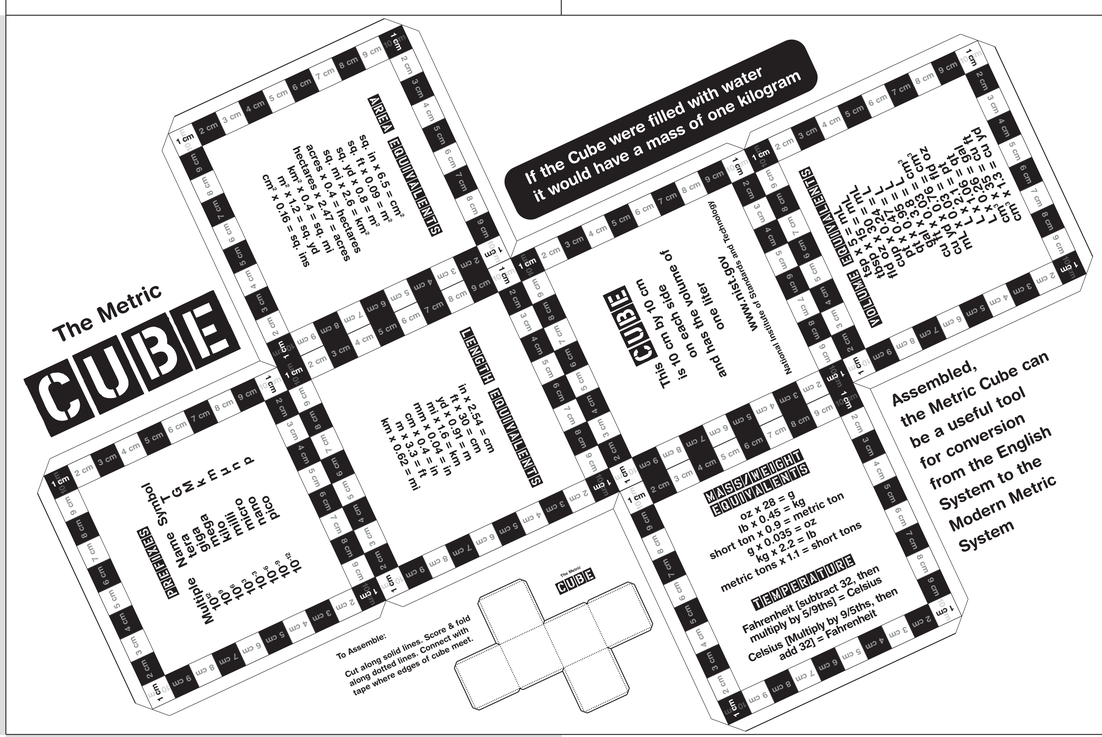
What is the area of this poster?

How could you use this in class?

Destination Tomorrow

Destination Tomorrow: Bringing the Future into Focus, is a 30-minute educational series designed for educators, parents, and lifelong (adult) learners. The series communicates knowledge resulting from NASA's Aerospace Technology research. The format consists of quick-paced segments ranging from 2-6 minutes. Segment content draws from NASA aerospace technology projects, facilities, and people. Destination Tomorrow seeks to increase the scientific literacy of our citizens and to provide viewers with a better understanding of how our world is shaped by mathematics, science, and technology.

Off air rights to the NASA "Why?" Files, NASA CONNECT, and Destination Tomorrow are granted in perpetuity; no fees or licensing agreements are required. Neither the broadcast nor the educator guide is copyrighted. NASA "Why?" Files and NASA CONNECT programs are delivered via Ku- and C-band satellite broadcast and air on PBS-member stations, and Destination Tomorrow airs on cable access stations. All programs appear on NASA TV and are Web-cast on NASA's Learning Technologies Channel. Video copies of the programs can be purchased from CORE, NASA's Central Operation of Resources for Educators (see panel 12).



To the Educator

The purpose of this poster is to help you inspire, educate, and encourage your students to learn about the Wright brothers, the celebration of the 100th anniversary of flight, and the history of aviation and aerospace. The classroom activities are designed to provide hands-on experiences for your students that relate to some of the engineering processes employed by the Wright brothers and others. All of the activities utilize the metric system and relate to the National Mathematics Standards of Measurement. As students, printers, and bicycle mechanics, Wilbur and Orville Wright used the traditional inch/pound system that is still the standard measurement system used in the United States. However, during their flight tests in North Carolina, they measured wind speed in meters per second as opposed to miles per hour. As your students investigate how the Wright brothers solved the mysteries of mechanical flight, perhaps they will discover why the metric system was used. We encourage you to use the information provided on this poster to teach your students about the metric system, its history, use, and importance.

Three sources of information—The U.S. Centennial of Flight Commission's Web site (**www.centennialofflight.gov**), the page titled "NASA Resources for Educators," and the "Extensions and Technology Connections" section—will help you and your students locate additional information, educational products, and activities related to the Wright brothers and the history of aviation and aeronautics.

A Few Questions to Get Your Students Started
The State motto of North Carolina is "First in Flight." How and why did two brothers from Ohio select this location for their first flight? How did they get there? How often did they go to North Carolina? How long did they stay? Where did they live? Who helped the Wright brothers when they conducted their experiments? Were their machines transported from one State to the other? If so, how?

Why is the State of Ohio known as "The Birthplace of Aviation?" Where did the Wright brothers live in Ohio? What did they do there? How did they become interested in aviation?

Although the States of North Carolina and Ohio are well known for early developments in aviation, many people from other States and countries around the world were thinking about flight, building aircraft, and conducting experiments before, during, and after the Wright brothers' involvement in flight. Who were these people? Where did they live? What contributions did they make?

Study your State's aviation and aerospace history. Discuss how the advances in aviation and aerospace during the past 100 years have affected you and your family. Imagine what changes will occur in aviation and aerospace in the next 100 years. Design a poster representing the history of aviation and aerospace in your State. Create a calendar with information about significant people, places, and historical aviation and aerospace events in your State. Share your poster and calendar with others in your school, community, or State. Send an electronic copy of your poster and your calendar to the U.S. Centennial of Flight Commission's Web site e-mail address (**centennialofflightadmin@hq.nasa.gov**). Plan your own centennial of flight celebration. If you believe your event meets the criteria for inclusion on the Commission's calendar, complete and submit the electronic form found on the Centennial Web site.

NASA Resources for Educators

NASA's Central Operation of Resources for Educators (CORE) was established for the national and international distribution of NASA-produced educational materials in audiovisual format. Educators can obtain a catalogue and an order form by one of the following methods:

• NASA CORE
Lorain County Joint Vocational School
15181 State Route 58
Oberlin, OH 44074-0799
• Toll Free Ordering Line: 1-866-776-CORE
• Toll Free FAX Line: 1-866-775-1401
• E-mail nasaco@leeca.org
• Home Page: http://core.nasa.gov

Educator Resource Center Network (ERCN)
To make additional information available to the education community, NASA has created the NASA Educator Resource Center (ERC) network. Educators may preview, copy, or receive NASA materials at these sites. Phone calls are welcome if you are unable to visit the ERC that serves your geographic area. A list of the centers and the regions they serve includes:

AK, Northern CA, HI, ID, MT,
NV, OR, UT, WA, WY
NASA Educator Resource Center
Mail Stop 253-2
NASA Ames Research Center
Moffett Field, CA 94035-1000
Phone: (650) 604-3574

IL, IN, MI, MN, OH, WI
NASA Educator Resource Center
Mail Stop 8-1
NASA Glenn Research Center
21000 Brookpark Road
Cleveland, OH 44135-3191
Phone: (216) 433-2017

CT, DE, DC, ME, MD, MA, NH,
NJ, NY, PA, RI, VT
NASA Educator Resource Laboratory
Mail Code 130.3
NASA Goddard Space Flight Center
Greenbelt, MD 20771-0001
Phone: (301) 286-8570

CO, KS, NE, NM, ND, OK, SD, TX
Space Center Houston
NASA Educator Resource Center for
NASA Johnson Space Center
1601 NASA Road One
Houston, TX 77058-3696
Phone: (281) 244-2129

FL, GA, PR, VI
NASA Educator Resource Center
Mail Code ERC
NASA Kennedy Space Center
Kennedy Space Center, FL 32899-0001
Phone: (321) 867-4090

Virginia Air & Space Center
Educator Resource Center for
NASA Langley Research Center
600 Settlers Landing Road
Hampton, VA 23669-4033
Phone: (757) 727-0900 x 757

AL, AR, IA, LA, MO, TN
U.S. Space and Rocket Center
NASA Educator Resource Center for
NASA Marshall Space Flight Center
One Tranquility Base
Huntsville, AL 35812-0001
Phone: (256) 544-5812

MS
NASA Educator Resource Center
Building 1200
NASA Stennis Space Center
Stennis Space Center, MS 39529-6000
Phone: (228) 688-3965

NASA JPL Educator Resource Center
Village at Indian Hill
1460 East Holt Avenue, Suite 20
NASA Jet Propulsion Laboratory
Pomona, CA 91767
Phone: (909) 397-4420

AZ and Southern CA
NASA Educator Resource Center for
NASA Dryden Flight Research Center
45108 N. 3rd Street East
Lancaster, CA 93535
Phone: (661) 948-7347

VA and MD's Eastern Shores
NASA Educator Resource Center
Visitor Center Building J-17
CSFC/Wallops Flight Facility
Wallops Island, VA 23337-5099
Phone: (757) 824-2298

Regional Educator Resource Centers offer more educators access to NASA educational materials. NASA has formed partnerships with universities, museums, and other educational institutions to serve as regional ERCs in many states. A complete list of regional ERCs is available through CORE, or electronically via NASA Spaceflink at http://spaceflink.nasa.gov/ercn/

NASA's Education Home Page serves as a cyber-gateway to information regarding educational programs and services offered by NASA for the American education community. This high-level directory of information provides specific details and points of contact for all of NASA's educational efforts, Field Center offices, and points of presence within each state. Visit this resource at the following address: http://education.nasa.gov

NASA Spaceflink is one of NASA's electronic resources specifically developed for the educational community. Spaceflink is a "virtual library" in which local files and hundreds of NASA World Wide Web links are arranged in a manner familiar to educators. Using the Spaceflink search engine, educators can search this virtual library to find information regardless of its location within NASA. Special events, missions, and intriguing NASA Web sites are featured in Spaceflink's "Hot Topics" and "Cool Picks" areas. Spaceflink may be accessed at: http://spaceflink.nasa.gov

NASA Spaceflink is the official home to electronic versions of NASA's Educational Products. A complete listing of NASA Educational Products can be found at the following address: http://spaceflink.nasa.gov/products

NASA Television (NTV) features Space Shuttle mission coverage, live special events, interactive educational live shows, electronic field trips, aviation and space news, and historical NASA footage. Programming includes a 3-hour block for Video (Nova) File, NASA Gallery, and Education File. Programming begins at noon Eastern time and is repeated five more times throughout the day. Live feeds preempt regularly scheduled programming.

Check the Internet for programs listings at:
http://www.nasa.gov/ntv
For more information on NTV, contact:
NASA TV
NASA Headquarters
Code P-2
Washington, DC 20546-0001
Phone (202) 358-3572

EW-2000-11-134-HQ
The Wright Way: Innovation Through Engineering
Please provide feedback on how this poster has been used. Complete the survey at
https://ehb2.gsfc.nasa.gov/edcats/educational_wallsheet

A Metric Distance Ditty

From Chesapeake to Richmond,
shows 100,000 meters,
or from Tampa to Orlando,
stretch 100 kilometers.

It's 200 kilometers,
Chattanooga-Birmingham,
or Milwaukee to Green Bay,
Walla Walla to Spokane.

It's 300 kilometers,
from St. Cloud to Albert Lea,
San Antonio to Houston,
Vicksburg, Miss., to New Orleans.

It's 400 kilometers,
from Las Vegas to L.A.,
or Chicago to Detroit,
Grand Bahama-Tampa Bay.

It's 500 kilometers,
from Fort Worth to Mexico,
or St. Paul to Omaha,
New York City-Buffalo.

It's 1,000 kilometers,
from Racine to Wichita,
Newport News to Terre Haute,
or Thunder Bay to Omaha.

And a 1,000 kilometers,
could a megameter be.
That's the height of California,
or from Salt Lake to the sea.

Poems by Mark Henschel

How many kilometers is your city from the Nation's capital?

Poster Credits

"The Wright Way: Innovation Through Engineering," was developed by NASA Headquarters' Education Division, Office of Human Resources and Education, Frank C. Owens, Director of Education, Anne Holbrook, NASA Einstein Fellow, created the poster with oversight from Debbie Calloway, Assistant Director of Programs for the U.S. Centennial of Flight Commission and William E. Anderson, Partnership Manager for Education, Office of Aerospace Technology. Shelley Canright, Deborah Hale, Peg Steffen, Sonja Godekker, and Judy Sink made numerous contributions to the poster. Jennifer Pulley and Cheryl Keeton from NASA Langley Research Center provided some activity ideas. The following individuals were consulted during the development of the poster: Linda Hallenbeck, Teacher in Residence for Governor Bob Taft of Ohio; Leila Reigelsperger, Princeton City Schools librarian; and Karen Garr, Teacher in Residence for Governor Jim Hunt of North Carolina.

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Metric Numbers to Remember

This table contains numbers that people often commit to memory. Many of these metric values are nice round numbers, and therefore easier to remember than the customary unit equivalent.

Measurement of:	Metric Units	Customary Units
Speed of Light	300 000 km/s	186 000 mi/s
Distance between Earth and Sun	150 000 000 km	93 000 000 mi
Distance between Earth and Moon	385 000 km	240 000 mi
Circumference of Earth	40 000 km	25 000 mi
Geostationary Satellite Altitude	35 800 km	22 300 mi
Freezing Point of Water	0 °C	32 °F
Standard Human Body Temperature	37 °C	98.6 °F
Boiling Point of Water	100 °C	212 °F
Density of Water	1 g/mL or 1 kg/L	8.35 lb/gal
Height of Mount Everest	8 850 m	29 035 ft

Launch A Career in Engineering

Is engineering for you?

Do you enjoy:
- Finding out how things work?
- Solving problems and puzzles?
- Creating and building things?
- Working with computers?
- Studying science and mathematics?

If you answer yes to most of these questions, consider engineering as a career. Engineers work in many areas. NASA engineers work in these and other fields:

- Aerospace Engineering
- Ceramic Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Electrical and Electronic Engineering
- Industrial Engineering
- Mechanical Engineering
- Metallurgical Engineering
- Nuclear Engineering

What kind of engineer could you become?
Find out what each of the engineers listed does and what their qualifications are.

Access career information, educational information and instructional resource materials, and engineering information at the following Web sites:
National Society of Professional Engineers
www.nspe.org

Teachers, check out National Engineers Week Activities—a February event each year!
www.eweek.org

MATHCOUNTS is fun, challenging and it works!
Find out how to solve all your middle school math problems at:
www.mathcounts.org

Enter the International Aviation Art Contest

This art contest is held each year for elementary and secondary students. Read all about it!

Visit the Federation Aeronautique International at:
www.fai.org/education

NASA Student Competition Opportunities!

To find out more information about how students can participate, visit the NASA Student Involvement Program (NSIP) Web site at http://education.nasa.gov/nsip/index.html

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1903–2003
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