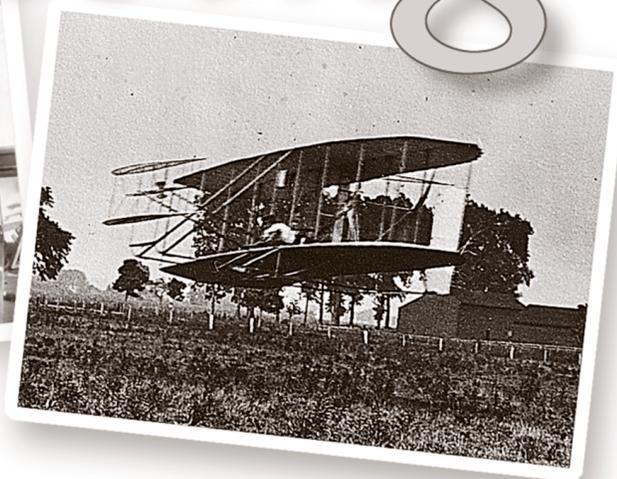
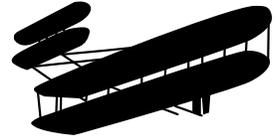


# from to wheel wing



A guide to teaching  
the invention of flight



# Wright Brothers Teacher's Guide

This curriculum guide was developed in partnership by Dayton Aviation Heritage National Historical Park and the *Dayton Daily News* Newspapers In Education (NIE) program as an outreach to students. This information focuses on the Wright brothers' work in Dayton, Ohio, which led to the invention of free, controlled and sustained flight in a power-driven, heavier-than-air machine.

As we approach the 100th anniversary of flight and increased attention is given to the achievements of the Wright brothers, this guide — based on state and national standards — is intended to enrich your existing classroom curricula.

Included is background information on the Wright brothers with guided questions, teacher instructions and six student activity sheets. Supplemental materials included are a list of Web sites and books, an Aviation Trail brochure and Dayton area map.

We hope you find this to be a useful educational tool for your classroom. Enjoy your trip along the Aviation Trail!

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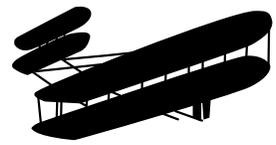
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**Photos courtesy of Special Collections and Archives, Wright State University.**

Dayton Daily News





## Teacher's Guide

### Introduction and the Family of the Wright Brothers

#### PRELEARNING ACTIVITY

**Ask students:**

What do you know about the founders of aviation?

**Guide students to identify:**

- Wright brothers, Wilbur and Orville
- Dayton, Ohio
- Kitty Hawk, North Carolina
- The brothers' jobs — printing and bicycle shops
- First successful flight in 1903

#### INTRODUCTION

Most people have heard of the Wright brothers. Likely, people know they came from Dayton and invented flight. Few people, however, know much about their nature, or about how they achieved flight. This guide will provide information on the Wrights and ideas on how to use it with your students.

Consider, though, the magnitude of their achievement. Flight was a dream of centuries, going back to Greek myth and beyond. In 1900, powered heavier-than-air flight was commonly considered impossible – against the laws of physics. Notable people from Leonardo da Vinci to Thomas Edison and Alexander Graham Bell had investigated flight, without success. The Wrights achieved flight in five years, working part-time, for less than \$1,000.

**Ask students:**

What is significant about the Wright brother's heavier-than-air flight?

**Stress** that most people felt that flight was impossible and that many significant inventors had tried and failed. Also, the Wright brothers did this in five years for less than \$1,000.

#### THE WRIGHT FAMILY

Wilbur and Orville's parents — Milton and Susan Wright — met at Hartsville College, a tiny religious school in Indiana. Milton became a bishop of the

Church of the United Brethren in Christ; for many years, he had charge of the church's publishing work, conducted here in Dayton. With Milton often absent on church business, Susan was a strong influence on the children. From their mother, Wilbur and Orville acquired two single traits: their shyness — hers was fierce — and their mechanical aptitude. She built a sled, made toys and kept various household appliances in repair. Susan Wright died of tuberculosis in 1889, when Wilbur was 22 and Orville was 17.

There were five Wright children. The eldest, Reuchlin, moved to Kansas as a young man. The second, Lorin, settled in Dayton with his family. After Wilbur and Orville came Katharine, the youngest and only girl.

For many years, the Wright family lived at 7 Hawthorne Street in West Dayton. Milton and Susan Wright purchased the home from its builder for \$1,800 in 1870, when the Wright family moved here from Indiana. In the years when Wilbur and Orville worked on flight, they lived on Hawthorne Street with their father and sister.

**Read** "The Wright Family" aloud to your students.

**Ask:**

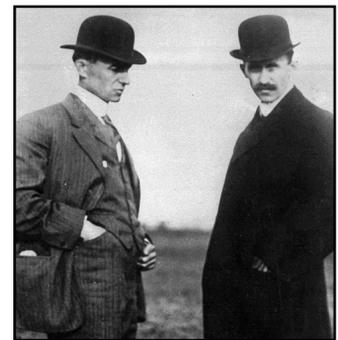
What character traits of Wilbur and Orville's mother influenced their future success?

#### THEY DIFFERED

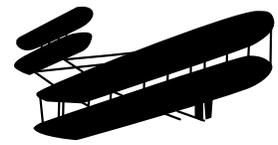
Because people commonly speak of Wilbur and Orville as the Wright brothers, the differences between them get overlooked.

Wilbur was four years older. He was an extremely responsible person and served as his mother's chief nurse during her long illness.

He was a very clear thinker and writer. Flight was an extremely



*While they worked closely together, the Wright brothers were different in many ways.*



## Teacher's Guide

### The Careers of the Wright Brothers

complicated problem — Wilbur had the capacity to keep the various parts of the problem, and how each part related to each other part, clearly in mind.

Wilbur was casual about his appearance, Orville was a careful dresser. In their work on flight, he was the more inventive and the better mathematician. Orville was an entrepreneur. When he was five, he collected bits of road tar, rolled them in sugar, wrapped them in waxed paper and sold them to friends as chewing gum.

**Read** "They Differed" aloud to students.

**Compare and contrast** the character traits of Wilbur and Orville.

**Do** the activity sheet titled "They Differed".

#### CAREERS

For most of their lives, the Wright brothers worked for themselves and with each other. They had three main careers: printing, cycling and aviation.

##### **Printing:**

In 1888, Orville built a small press and entered the printing business. Wilbur soon joined in. They published a small newspaper, *West Side News*, and, for a time, a full-sized newspaper, *The Evening Item*, directed at Dayton's West Side. They also printed reports, circulars and other work. Printing became their occupation. The work promoted a sense of exactness and gave them experience at making decisions, handling money and dealing with customers.

At one point, Orville worked with Paul Laurence Dunbar. They knew each other from Central High School; Dunbar, of course, later gained fame as a poet and author. Dunbar wrote and Orville Wright printed the *Dayton Tattler*, a publication aimed at Dayton's African-American residents. Dunbar had difficulty raising money to finance the



Paul Laurence  
Dunbar

project. Orville later stated, "We published it as long as our financial resources permitted, which was not very long." Three issues, in fact.

##### **Bicycles:**

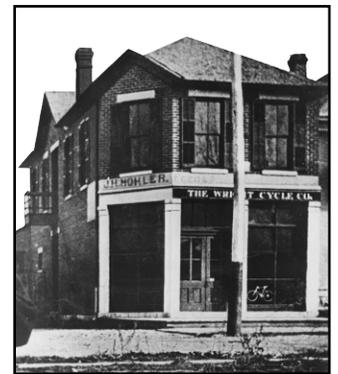
With printing, the Wrights turned an interest into a business. With bicycles, they did likewise. They were partners. Printing and cycling both provided ways for them to work together at something that interested them and to pay their expenses. Printing and bicycle making helped them develop a range of mechanical skills. They learned how to use tools to work metal, wood and other materials to create the things they could imagine.

##### **Aviation:**

Their work on aviation was different.

First, while what the Wrights did in printing and cycling was new to them, many others had done similar things before. In aviation, they explored an uncharted realm.

Second, the print shop and bike shop produced immediate income. While aviation became valuable in time, it produced no income when they were working on it. The brothers continued to operate their bike shop, using its profits to support themselves while they worked on flight.



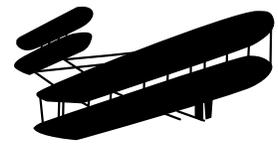
The Wright Cycle Company building,  
1895-1897.

Either **read aloud** or **retell** the information in "Careers".

##### **Ask students:**

How did the Wright brothers' work with printing and bicycles help them accomplish their aviation dreams?

**Discuss** the elements of cause and effect that allowed them to explore flight.

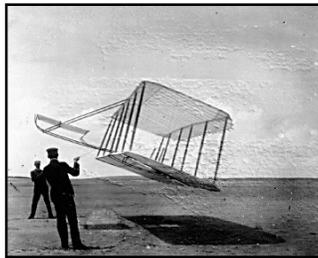


## Teacher's Guide

### Starting Point

#### STARTING POINT

On August 9, 1896, a German engineer named Otto Lilienthal crashed the glider he was flying. He died the following day. Lilienthal was the world's leading experimenter with gliders, making over 2,000 flights of ten seconds or less in gliders of his design. His exploits received considerable attention in the press. Wilbur Wright stated that word of Lilienthal's death prompted his active interest in flying.



*The Wright brothers first tested their gliders as kites.*

Before undertaking any experiments, Wilbur wanted to know all he could about what others had tried. He wrote to the Smithsonian Institution in Washington for a list of books about aviation. He sought additional information from the Dayton Public Library.

Wilbur and Orville read and discussed this research. They considered what others had attempted and analyzed why they may have failed. In 1899, they built and tested a kite with a five-foot wingspan.

#### Ask students:

What are some of the things the Wright brothers did to start learning about aviation?

#### PREPARATION

Between them, Wilbur and Orville had the abilities needed to create flight.

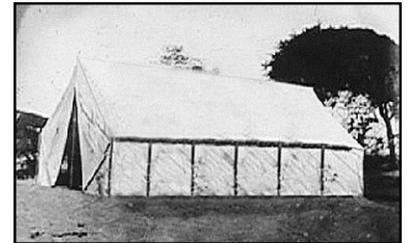
- They were clear thinkers, and good at math.
- From working with bicycles, they knew how to combine strength and light weight.
- From working as printers, they knew how to be precise.
- They were physically strong and agile. Flying their gliders took strength and agility.
- They had the confidence of their family, their father and sister in particular.
- They had their partnership. Wilbur and Orville had over a decade of experience working together.
- And they could sew. The gliders' wings were covered with muslin cloth. Orville did the cutting; Wilbur did the sewing.

Have students **identify** three abilities of the Wright brothers and **describe** how each affected their capacity to create flight.

#### KITTY HAWK

In 1900, the Wrights planned to build a glider large enough to carry a pilot. Where should they fly it? They wrote to the U.S. Weather Bureau to get a list of windy places. One was Kitty Hawk, North Carolina. Kitty Hawk is on a long, narrow island off the North Carolina mainland. Wilbur wrote to people in Kitty Hawk for additional information.

William J. Tate, a minor official in Kitty Hawk, replied, "You could get a stretch of sandy land one mile by five with a bare hill in the center 80 feet high, not a tree or bush anywhere to



*Camp at Kitty Hawk used by the Wright brothers in 1900.*

break the evenness of the wind current." That sounded good. Steady winds to fill their wings; sand for soft landings. Because of the same sandy beaches that attracted Wilbur and Orville, many tourists now visit Kitty Hawk. In 1900, however, there was no place on the island to stay. Wilbur and Orville had to bring a tent.

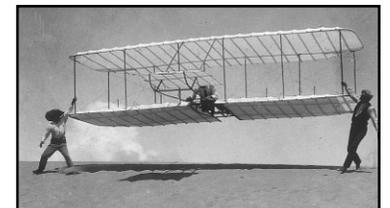
#### Ask students:

Why didn't Wilbur and Orville test their airplane in Dayton, Ohio?

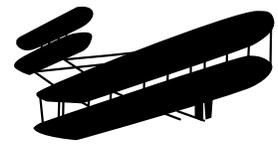
#### SETBACKS

In September 1900, the Wrights took their glider to Kitty Hawk. They returned the following year with an improved version. To their disappointment, neither was a success.

In practice, the gliders lifted only half or less of the weight they had anticipated. Leaving North Carolina in 1901, Wilbur



*Launching the Wright's 1901 glider.*



## Teacher's Guide

### Breakthrough

said, "We considered our experiments a failure. At this time I made the prediction that people would sometime fly, but that it would not be within our lifetime."

In designing their gliders, the Wrights relied on tables developed by Otto Lilienthal on the relationship between wing shape and lift.

The Wrights decided Lilienthal's figures were wrong. Wilbur later wrote, "Having set out with absolute faith in the existing scientific data, we were driven to doubt one thing after another, till finally, after two years of experiment, we cast it all aside, and decided to rely on our own investigations."

In their bike shop, the Wrights built the first wind tunnel specifically intended for aeronautical research. In it, they tested dozens of model wings to see how the lift a wing produced differed with length, width and curvature. Of this period, Orville later wrote, "Wilbur and I could hardly wait for the morning to come to get at something that interested us. That's happiness."



*The wind tunnel was significant in allowing the Wrights to develop correct aeronautical data. Wind tunnels — significantly larger — are used by the aircraft industry for designing and testing modern aircraft.*

#### Ask students:

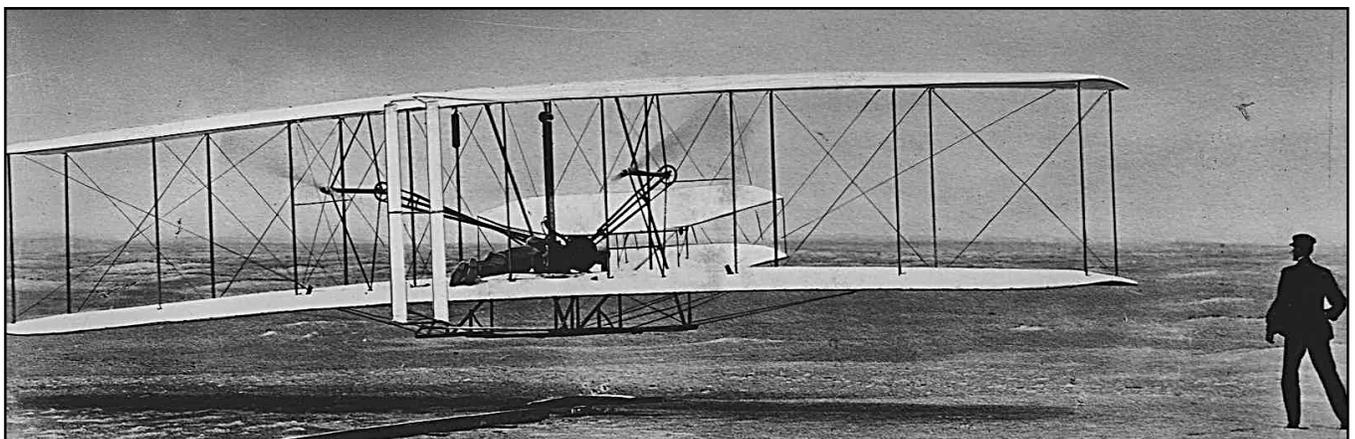
**Write** the following quote on the chalkboard. "Insanity is continuing doing the same things and expecting different results." — Albert Einstein

**Ask students:** How is this quote from Albert Einstein reflected in the action of the Wright brothers?

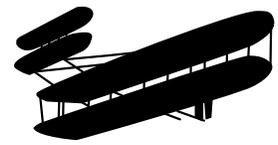
#### BREAKTHROUGH

With their wind tunnel data they designed a new glider for 1902. Their earlier gliders had been stubby and clumsy-looking: their new glider had wings that were long and slender. At Kitty Hawk in 1902, their new glider skimmed effortlessly over the dunes. In two months they made over 1,000 glides; the longest was 622.5 feet and lasted 26 seconds.

The glider's performance confirmed the accuracy of their wind tunnel data. This had major implications. Years later, Orville wrote, "When we were carrying on our wind-tunnel work we had no thought of ever trying to build a powered aeroplane. But after we had demonstrated in a glider that our tables were correct, we saw...it would not be hard to design a man-carrying powered aeroplane."



*Perhaps the most famous of all the Wright photos, this picture is the only photo of the first flight that occurred on December 17, 1903. Orville piloted the airplane for twelve seconds, flying 120 feet.*

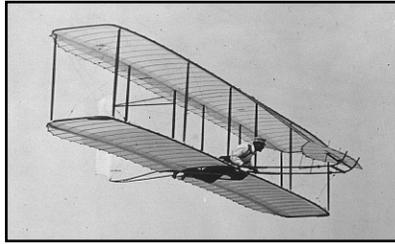


## Teacher's Guide

### First Powered Flight

#### Ask students:

What was the breakthrough that led to “a man-carrying powered aeroplane”?



*A 1902 glider in flight.*

#### PROBLEM SOLVERS

Many people think of Wilbur and Orville as hands-on workers, shaping the pieces of their flying machine in their bike shop or testing their gliders over the sand dunes of Kitty Hawk. Their work, however, was primarily mental. Flight posed a series of problems which Wilbur and Orville talked through in the family parlor at 7 Hawthorne Street. A niece, Ivonette, recalled, “One of them would make a statement. There’d be a long pause, and then the other one would make a statement, and then the other one would say, ‘tisn’t, tisn’t either,’ and then it would be ‘tisn’t either,’ ‘tis too,’ ‘tisn’t either,’ and then there’d be a long pause again.”

Characteristically, the brothers would take turns arguing one side of a proposition, then switch sides and argue again. They did not proceed to discussion of the next point until agreement on each prior step was reached.

Turning their glider into a powered machine presented two major tasks. First, they needed to design propellers. Second, they needed to build an engine. The Wrights handled the first task; the second — building the engine — was largely done by Charlie Taylor, their mechanic.

Have students **describe** problem-solving strategies they use when trying to accomplish something.

DECEMBER 17, 1903

On December 17, 1903, the wind was up at Kitty Hawk. On hand were Wilbur and Orville and crew members from the nearby federal lifesaving station, who helped the Wrights maneuver their aircraft over the

sand. For launching, the aircraft slid down a wooden rail. One lifesaver, quoted by Wright biographer Tom Crouch, said that prior to Orville’s first flight, “We couldn’t help notice how they held on to each other’s hand, sort o’ like two folks parting who weren’t sure they’d ever see one another again.” Orville’s first flight went about one hundred feet — less than the distance from home plate to second base — and the skies had been conquered.

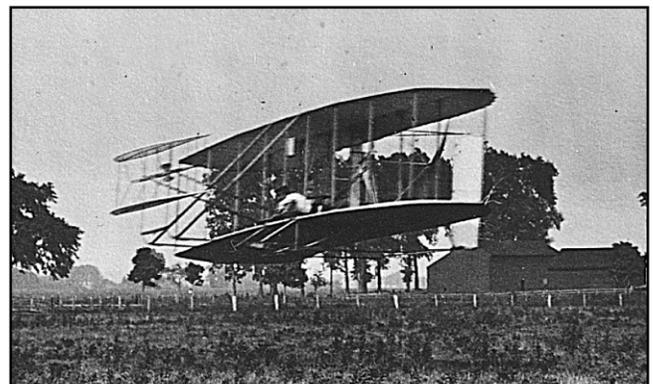
#### Ask students:

What emotions do you think the Wright brothers felt before, during and after that first famous flight?

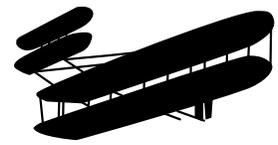
#### HUFFMAN PRAIRIE FLYING FIELD

After their success at Kitty Hawk, the Wrights had additional work to do to make flight not only possible, but practical. They did this work in 1904 and 1905 at Huffman Prairie Flying Field, ten miles east of Dayton. Working at Huffman Prairie Flying Field let them live at home. Besides being more comfortable, living at home let them work in their bike shop to make or modify parts as needed.

Initially, progress was slow. The winds near Dayton were not as strong as in North Carolina. The cow pasture was not as soft to land on as the sand dunes at Kitty Hawk. The Wrights made 41 flights in 1904 before making one longer than their best effort at Kitty Hawk. But they persevered, and by October 1905 they had a fully operational aircraft. It would take off, fly, turn and land at their command.



*The 1904 Wright Flyer in flight at Huffman Prairie Flying Field.*



## Teacher's Guide

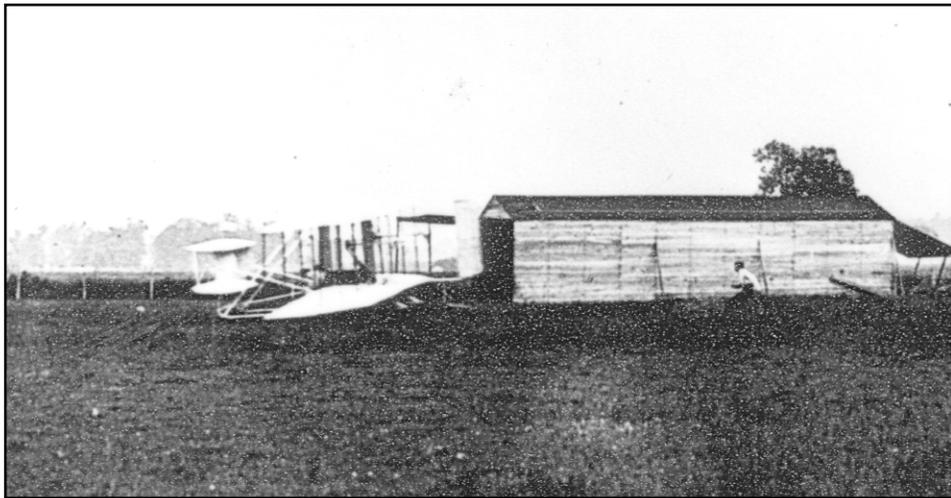
### Huffman Prairie Flying Field

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**Discuss** what might have happened if the Wright brothers had stopped at Kitty Hawk and not continued their experiments at Huffman Prairie Flying Field.

Often, we think of history as something that happened far awhile and long ago. Much of the Wright brothers' history, however, is still available:

- The Wright Cycle Company building was the location of the Wright brothers' bicycle shop from 1895 to 1897. It is now part of Dayton Aviation Heritage National Historical Park.
- The 1905 Wright Flyer III, the world's first fully controllable aircraft, is on display at Carillon Historical Park in Dayton.
- The Huffman Prairie Flying Field, now part of Wright-Patterson Air Force Base, is open daylight hours when the base is open to the public. The vegetation is taller now than it was when cows grazed there, but a replica of the Wrights' 1905 hangar exists.



*The Wright brothers flew many times at Huffman Prairie Flying Field. This photo was taken in late June, 1905.*



## Teacher's Guide

### Resource List

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#### Web sites

[www.dayton.lib.oh.us](http://www.dayton.lib.oh.us)

This is the Dayton & Montgomery County Public Library Web site. There are several locations for children, teens and those just wanting local history information. Most pages give a brief account of the Wright brothers, but it takes many clicks of the mouse to get to them.

[www.hfmvgv.org/histories/wright/wrights.html](http://www.hfmvgv.org/histories/wright/wrights.html)

This is a wonderful short and simple Web site on the Wright brothers. It describes their childhood, the Wright Cycle Shop and the world's first airplane. It also provides a chronology and a list of books and places people should visit if they want more information.

[hawaii.psychology.msstate.edu/invent/air\\_main.shtml](http://hawaii.psychology.msstate.edu/invent/air_main.shtml)

This is a virtual museum covering the invention of the airplane. It has a few biographies of the Wright brothers, and it also has simulations that, if you download, can be pretty cool. One lets you see the world's first flight as if you were the pilot. This site also includes a list of historic planes and information about them and a biographical list of inventors.

[www.fi.edu/flights](http://www.fi.edu/flights)

This site was created by the Franklin Institute Science Museum for just about everyone. There's a simple, easy-to-read biography of the Wright brothers with some photos that you can enlarge. There are a few fun activities for students to look at and study, as well as a link for teachers.

[firstflight.open.ac.uk](http://firstflight.open.ac.uk)

Firstflight gives a nice chronology of key events in aviation. It then gives a brief description of some aerodynamic terms that the Wright brothers would have been familiar with. Also included is a list and brief biographies on several aviation experimenters who lived both before and at the time of the Wright brothers.

[www.nasm.edu/nasm/aero/aircraft/ntoz.htm](http://www.nasm.edu/nasm/aero/aircraft/ntoz.htm)

This is the National Air and Space Museum of the Smithsonian Institution Web site. It gives fairly thorough descriptions of the Wright 1903 Kitty Hawk

Flyer, the Wright 1909 Military Flyer, and the Wright EX "Vin Fiz," including the history behind them and the Wright brothers.

[www.aero-web.org/history/wright/wriframe.htm](http://www.aero-web.org/history/wright/wriframe.htm)

This is Orville Wright's own account of how he and Wilbur made the first flight. He gives detailed descriptions of everything from how they made their engine to how they calculated various measurements. It's an excellent site if you need more than just a brief biography. Includes photographs.

[www2.una.edu/history/start.htm](http://www2.una.edu/history/start.htm)

This is a short site where everything is easy to find. It gives a very brief biography of the Wright brothers and describes how they went about building their flyer. It also provides a list of additional links and books for more information on the Wright brothers.

[www.pbs.org/wgbh/amex/wright/transcript.html](http://www.pbs.org/wgbh/amex/wright/transcript.html)

This PBS site has the program script from the documentary, *The Wright Stuff*. It is thorough, and includes many historians and relatives of the brothers, such as Tom Crouch, the curator of Aeronautics of the National Air and Space Museum, and Ivonette Wright Miller, the Wright brothers' niece. Includes a link where you can hear a live interview with a National Park Service employee and a historian about the Wright brothers. Includes a book list.

[www.allstar.fiu.edu/aero/wrightbros.htm](http://www.allstar.fiu.edu/aero/wrightbros.htm)

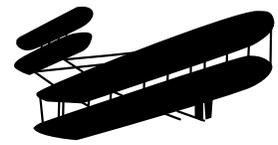
This Allstar site is perfect for students and educators. It contains information on aviation history in general, including the Wright brothers, and review questions for students to complete online. There is also a teacher's resource guide.

[www.nps.gov/wrbr](http://www.nps.gov/wrbr)

This is the Wright Brothers National Memorial in North Carolina Web site. It has a brief biography of the Wright brothers, with a few pictures. It links to other National Park Service sites, as well as aviation sites like Dayton Aviation Heritage National Historical Park.

[www.first-to-fly.com](http://www.first-to-fly.com)

This is the Wright Brothers Centennial Museum On-



## Teacher's Guide

### Resource List

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Line, and contains much information. It lists numerous aviation events going on in Ohio in the near future. In addition to giving a very thorough biographical account of the brothers, it gives information on all 19 types of airplanes they produced. Plus, it has a Wright family genealogy dating back to the 1500s. It also recommends several places to visit, books and videos to see, links to visit, and more.

[www.libraries.wright.edu/staff/dunbar/arch/ms1.htm](http://www.libraries.wright.edu/staff/dunbar/arch/ms1.htm)

This is the Wright Brothers Collection at Wright State University. At first, there is a lengthy description about how the university obtained the materials. Then there is a list of what is included in their Wright Brothers Collection and a biography about the brothers and their father.

[www.wam.umd.edu/~stwright/WrBr/Wrights.html](http://www.wam.umd.edu/~stwright/WrBr/Wrights.html)

This is a brief biography about the Wright brothers that focuses more on their experiments between 1900 and 1903 than anything else. There is some original material written by Wilbur and Orville that gives a unique perspective as to how they experimented, built their planes, and more. A book and several on-line resources are recommended.

[www.nps.gov/daav/](http://www.nps.gov/daav/)

Dayton Aviation Heritage National Historical Park commemorates the legacy of three exceptional men — Wilbur Wright, Orville Wright and Paul Laurence Dunbar — and their work in the Miami Valley. This site mainly gives just the general information for the park. There are also links to partnership sites of Dayton Aviation Heritage National Historical Park, including Huffman Prairie Flying Field, the 1905 Wright Flyer III, and the Paul Laurence Dunbar State Memorial.

### Books

#### *Juvenile*

Freedman, Russell. *The Wright Brothers: How They Invented The Airplane*. New York: Scholastic, 1991.

Filled with photographs, this book tells about the Wright brothers' childhood and their later success with flying. It describes the problems they had, and how they

fixed them. It also talks about a few others who attempted to fly.

Glines, Carroll V. *The Wright Brothers: Pioneers of Power Flight*. New York: Franklin Watts, Inc., 1968

This book tells about the Wright brothers in a fun, storybook way. It begins talking about their interest in aviation as children and then goes through their experiments. This book also talks about the beginning of the Air Force.

Haynes, Richard M. *The Wright Brothers*. Englewood Cliffs, NJ: Silver-Burdett Press, 1991.

The Wright Brothers tells the exciting story of the life and times of Orville and Wilbur Wright. Readers learn how events in Orville and Wilbur Wrights' early lives influenced them, as well as what problems they encountered. This biography explains how the Wright brothers designed and built their airplane and how they made the first successful flight in a power-driven plane.

Reynolds, Quentin. *The Wright Brothers*. New York: Random House, 1981.

This fun, yet informative, middle school-level book does an excellent job describing the Wright brothers' childhood. The author also writes about their interest in kites, printing, bicycles and gliders. Lastly, he talks about the brothers' fame and success after making the first motor-powered flight.

#### *Adult*

Crouch, Tom. *The Bishop's Boys: A Life of Wilbur and Orville Wright*. New York: W. W. Norton & Company, 1989

A recognized authority on early aeronautics and the Wright brothers, Crouch emphasizes their family background, their personality traits, and their attitudes toward life and work. It is a much-appreciated detailed account.

Fitzgerald, Catharine and Rosamond Young. *Twelve Seconds to the Moon*. Cincinnati, OH: C. J. Krehbiel Company, 1978.

This biography of the Wright brothers is told partly through text and partly through photographs and original Wright letters. It succeeds in giving a fairly thorough account of their life both as children and as aviators. Because it tells much of its history through



# Teacher's Guide

## Resource List/Teacher Information

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letters, the reader gets to know the Wright brothers and their family a little more intimately.

Web sites and books compiled by Dayton Aviation Heritage National Historical Park.

Additional information about the principles of flight can be found in the following videos available through SOITA and ITV Series on Think TV or ordered through the ITV Series Catalog.

Magic School Bus #209 Taking Flight  
NASA CONNECT

*Plane Weather*

*The Shapes of Flight*

*Wherever You Go, There You Are*

Wright At Home/Hawthorn Hill

Real Science #310 – High Flyers

Dr. Dad PH 3 II #1 Flight: Winging It

successful glider designs, then record and evaluate the data.



The Wright Flyer News

**Objective:** This activity will connect to many of the proficiency writing modes including summary, fictional, narrative, persuasive, informational, letter to the editor and journal.

This project requires students to research information and will take several days to complete. A list of Web sites and books to help with their research is provided in this guide. One strategy that could be used to accomplish this project is to divide the students into groups, having each group complete one or two components; thus, creating one class newspaper.



## TEACHER INFORMATION



They Differed

**Objective:** Students will compare and contrast aspects of the text.

Distribute activity sheets and have students read the information on the Wright brothers. You might want to use the teacher background information to supplement the information on the student sheets. After discussing the information, have students complete the Venn diagram.



Wright Math

**Objective:** Students will compute with whole numbers and decimals; compare and compute with common units of measure; and, use ratio and proportion within problem-solving situations. In the extensions, students will compare elements of

Poetry

**Objective:** Students will analyze aspects of the text; infer from the text; critique and evaluate aspects of the text; and, express reasons for recommending the text for a particular audience or purpose.



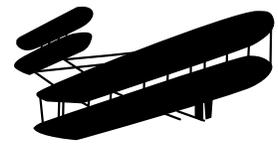
Mapping the Sites

**Objective:** Students will be able to identify significant sites related to the Wright brothers; enhance their measuring skills while using a map scale; learn how to use a grid on a map; and enhance their sequence writing skills by writing thorough directions.

**Materials needed:** map of the Dayton area, Aviation Trail brochure.

**Mapping the Sites — activity 1**

Give students time to look at a Dayton area map and locate sites they are familiar with. Go over with the students the proper way to use a map and how to find



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certain locations by using the map's grid. Next discuss the significance Dayton played in the history of aviation. Ask the students if they can name any site in Dayton related to flight. Distribute the "Mapping the sites" activity sheet and explain these are some of the sites on the Aviation Trail. Discuss some of the sites listed on the sheet. Have students locate each site on the list.

#### **Planning a Field Trip — activity 2**

##### **Part One**

Divide the class into groups of four. Inform them that they are in charge of planning a field trip to visit some of the sites on the Aviation Trail. (Use the list from "Mapping the sites.") Challenge the groups to come up with the best route to travel from one site to the next. If possible, have the students begin at their school and end the route back at their school. All 10 sites must be included in this field trip. Next, tell the students they are responsible for writing the directions for their field trip. Pretend the directions will be given to the bus driver, it is important to write details so the driver will not get lost. The challenge is to write clear directions and travel the shortest distance possible to save gas mileage.

##### **Part Two**

Have each cooperative group trade their field trip route with another group. Have each group follow the directions given and measure the mileage of the field trip. If a group cannot follow the directions, have them return the directions to the group that wrote the directions and ask for clarification. Once all the mileage is determined, display the route with the shortest mileage.

**Extension:** Have the students measure the distance of the Wright brothers' first flight (120 feet). Have the students run this distance. Have students time their speed and compare it to the 12 seconds of the Wright brothers' first flight. Graph the speed on a grid.

#### A Balancing Act

**Objective:** Students will be able to define the center

of gravity; understand how weight is caused by gravity; find an object's center of gravity; and understand the relationship between an object's weight and the object's center of gravity.

#### **Center of Gravity — activity 1**

**Materials needed:** student chair and sturdy wall.

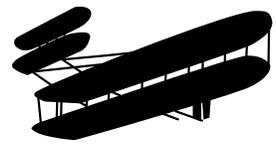
To introduce this lesson, have all students sit up straight in their chairs. Instruct them to stand. Ask them about the amount of effort it took for them to stand. Ask your students if standing was a difficult task. Next have your students hop forward. Comment on the amount of effort and how easy it was to hop forward. Have the students lift their left foot. Ask them what they had to do to remain balanced. Comment on how a person must adjust one's weight to his or her left side. Have students observe the other students' positions.

Now have your students sit back down in their chairs. Inform students that they will stand, hop and lift their left leg just like before but with a few weight adjustments. Have students sit up straight, feet flat on the ground, and arms straight at their sides. Now instruct students to stand without leaning forward and using no hands. Ask students to comment on how much effort it took to stand and why this simple task was so difficult. (The majority of the class will not be able to stand. At the end of the lesson, you might want to review this activity and explain to students the reason it was difficult to stand. Their center of gravity was over the chair. In order to stand, a person must shift his or her center of gravity over his or her feet. You need to lean forward to shift your weight, which changes your center of gravity. The objective of the activity is to have students start relating weight to the center of gravity.)

Next, have students stand. Instruct them to place their feet together, bend over, and grab hold of their toes with both hands. Tell the students to hop forward. Ask the students to comment on their experience. (In order to hop forward, you must lean forward to shift your center of gravity ahead of your feet. You cannot accomplish this task because you are holding your toes.)

Now, have students place their right arm and foot





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against a wall. Instruct them to lift their left leg. It is very difficult and most students will not be able to do the task. Ask the students to comment on the experience. (In order to balance on your right foot, you have to shift your weight, which will shift your center of gravity. Your center of gravity must be over your right foot. Since you cannot lean, due to the wall, it makes this simple task difficult.)

Discuss with your students that weight is the amount of force being pulled on a mass. Now that the students are beginning to understand the relationship of gravity and weight, introduce center of gravity. Define center of gravity as the point around which an object's weight is centered. Explain to them that to stay balanced as they walk, their center of gravity must be over their feet. A child's center of gravity is generally in the upper torso.

#### **Balanced Wings — activity 2**

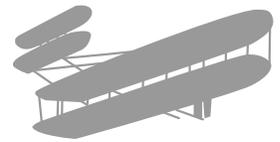
**Materials needed:** two equal-sized candles, cork, knitting needle, darning needle, two glasses, matches.

Distribute the "Balanced Wings" activity sheet. The following activity will help students to better understand the relationship of an object's weight and the object's center of gravity. Push a darning needle through the width of a cork. Push the same darning needle through a candle lengthways, starting at the bottom of the candle. Repeat this procedure using a different candle of equal size through the other end of the darning needle. Push a knitting needle lengthways through the cork and place the needle on the two glasses. The two candles should resemble a seesaw. Balance the candles up and down the needle until the two sides are balanced.

Now ask students to predict what will happen if they lit the ends of the candles. The students should begin discussing that the weight of the candles will change as the wax drips off the ends, which will change the seesaw's center of gravity, which then will cause the object to become unbalanced and begin to swing up and down. Light the candles. Explain to students that before the candles were lit, the seesaw's center of gravity was exactly on the axis so that both ends were balanced. When the wax drips off one end, the center of

gravity shifts to the other side. The candles will drip alternately causing the center of gravity to shift from one side to the other, causing the candles to teeter back and forth.

Relate this activity to how a person rides a bike. Discuss how center of gravity is important in building an airplane.



## They Differed

Name: \_\_\_\_\_

Milton and Susan Wright were the brothers' parents. Milton was a bishop in the Church of the United Brethren in Christ. With Milton often absent on church business, Susan was a strong influence on the children. From their mother Wilbur and Orville acquired two single traits: their shyness — hers was fierce — and their mechanical aptitude. She built a sled, made toys and kept various household appliances in repair. Susan Wright died of tuberculosis in 1889, when Wilbur was 22 and Orville was 17.

There were five Wright children. The eldest, Reuchlin, moved to Kansas as a young man. The second, Lorin, settled in Dayton with his family. After Wilbur and Orville came Katharine, the youngest and only girl.

Wilbur was four years older than Orville. He was an extremely responsible person and served as his mother's chief nurse during her long illness. He was a very clear thinker and writer. Flight was an extremely complicated problem — Wilbur had the capacity to keep the various parts of the problem, and how each part related to each other part, clearly in mind.

Wilbur was casual about his appearance; Orville was a careful dresser. In their work on flight, he was the more inventive and the better mathematician. Orville was an entrepreneur. When he was five, he collected bits of road tar, rolled them in sugar, wrapped them in waxed paper and sold them to friends as chewing gum.

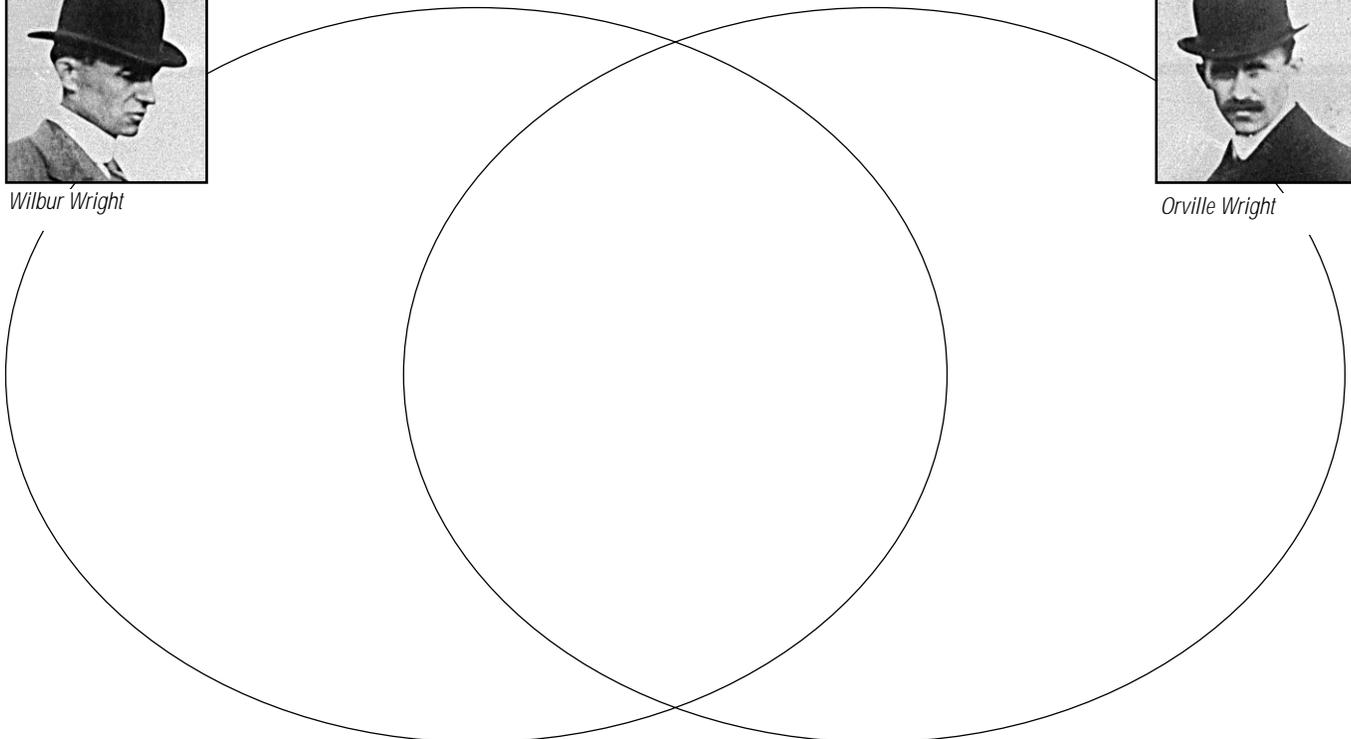
Using this information, as well as other information you know about Orville and Wilbur Wright, create a Venn diagram that compares and contrasts the two brothers.

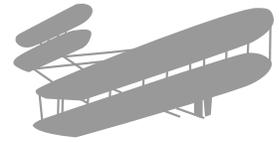


Wilbur Wright



Orville Wright

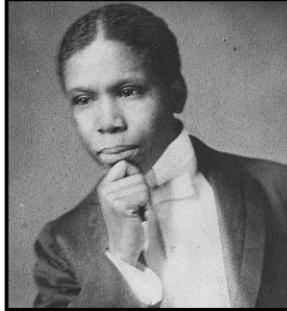




Name: \_\_\_\_\_

## Poetry

Printing put Orville Wright in business with Paul Laurence Dunbar. The two knew each other from Central High School. For a time, Dunbar wrote and Orville Wright printed the *Dayton Tattler*, a newspaper aimed at Dayton's African-American residents. By legend, Paul Laurence Dunbar scratched these lines on a wall in the print shop's back room:



Paul Laurence Dunbar

*“Orville Wright is out of sight  
In the printing business.  
No other mind half as bright  
As his'n is”*

Read “Dreams” and then answer the questions.

Dreams  
by Paul Laurence Dunbar

*What dreams we have and how they fly  
Like rosy clouds across the sky;  
Of wealth, of fame, of sure success,  
Of love that comes to cheer and bless;  
And how they wither, how they fade,  
The waning wealth, the jilting jade —  
The fame that for a moment gleams,  
Then flies forever, — dreams, ah — dreams!*

*O burning doubt and long regret,  
O tears with which our eyes are wet.  
Heart-throbs, heart-aches, the glut of pain,  
The somber cloud, the bitter rain,  
You were not of those dreams — ah! well,  
Your full fruition who can tell?  
Wealth, fame, and love, ah!  
    love that beams  
Upon our souls, all dreams —  
    ah! dreams.*

1. To what does the author compare the flight of dreams?

\_\_\_\_\_

2. What does the author mean by the phrase, “What dreams we have and how they fly?” Explain your answer with evidence from the poem.

\_\_\_\_\_

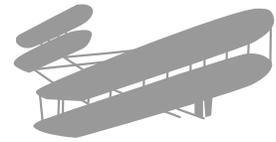
3. For whom would you recommend this poem and why?

\_\_\_\_\_

4. Can “dreams” fly? Defend your answer with evidence from your life experiences. (Complete your answer on back if needed.)

\_\_\_\_\_

\_\_\_\_\_



## Wright Math

Name: \_\_\_\_\_

The Wright brothers used many different elements of mathematics in all of their businesses, especially in the development of their aircraft. Below are a few problems related to the Wright brothers and the mathematics of aviation.

1. At Kitty Hawk in 1902, the Wright brothers tested their new glider across the sand dunes, making over 1,000 glides. Their longest glide was 622.5 feet and lasted 26 seconds. How many yards did they glide?

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**Extension:** Make your own paper glider and test it for distance. Make and test another style of glider. Measure the distance both gliders flew. Record your evaluation. Which one is the better glider and why?

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2. In 1912 you could purchase an airplane from The Wright Company for \$5,000. At today's prices, that same airplane would cost \$86,868.69. What is the difference in the prices from 1912 to 2000?

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**Extension:** What are some of the factors that might have created the difference in prices between 1903 and 2000?

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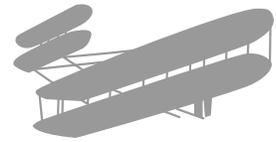
3. The Wright brother's first successful flight covered a distance of 120 feet in 12 seconds. If they could have remained aloft for one minute at that same rate, how far could they have flown? Explain your reasoning.

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Name: \_\_\_\_\_

## The Wright Flyer News

In 1888, the Wright brothers began working in the printing business. One of the things they did with this printing business was publish a small newspaper, *West Side News* and also *The Evening Item*.

Your challenge is to create a newspaper that includes many of the elements of a modern day newspaper, but is written as though it is the time the Wright brothers lived. All articles need to be related to the Wright brothers and their interests, such as bicycles, printing, aviation and their neighborhood.

Your final product needs to be at least four pages in length. You can type it in a two-column or three-column format. Be sure to include illustrations, photographs (with captions), and catchy headlines.

Page 1 should be the Front Page, which will include the following:

- Name for the newspaper and all of the components of a first page.
- Headlines.
- Articles about the first flight from more than one perspective. Be sure to include interviews with the Wright brothers, spectators and the people back home in Dayton.

Page 2 should be the Business Section, which could include:

- Stories about the effect that flight will have on businesses.
- Stories about the printing business.
- Stories about the bicycle business.

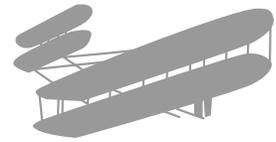
Page 3 should be the Social Section, which could include:

- Personal articles about the Wright brothers' lives.
- A story about Paul Laurence Dunbar.
- A poem written by Paul Laurence Dunbar.
- Your original poetry about the Wright brothers, their lives, businesses and aviation.
- A letter to the editor.
- A story about a social event.

Page 4 should be for Sports, Weather, and Advertisements:

- Sports, such as bicycle races in which the Wright brothers often participated.
- Weather conditions in Dayton, Kitty Hawk and the nation.
- Advertisements about products that were frequently used in the early 1900s.





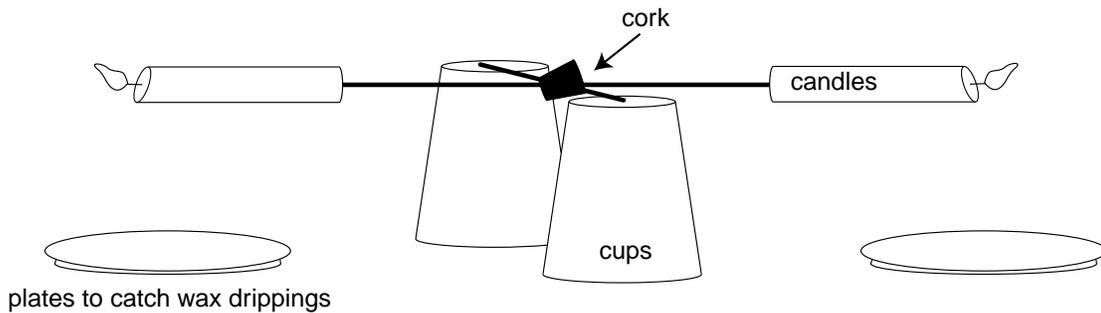
## Balanced Wings

Name: \_\_\_\_\_

In the 1890s, various people predicted that bicycle makers would invent flight. Two of the principles bicycle makers had to consider were:

- a. The bicycle frame must be balanced.
- b. The rider's center of gravity must be aligned with the center of gravity.

1. The design of a bicycle and an airplane is essential to the structure's center of gravity. Why?



This activity will help you to better understand the relationship of an object's weight and the object's center of gravity. Push a darning needle through the width of a cork. Push the same darning needle through a candle lengthways, starting at the bottom of the candle. Using a different candle of equal size repeat this procedure through the other end of the darning needle. Push a knitting needle lengthways through the cork and place the needle on two glasses. The two candles should resemble a seesaw. (See the illustration above.) Move the candles up and down the needle until the two sides are balanced.

1. Predict what will happen if you light the ends of the seesaw candles.

2. Light the candles. Record your observations on the back of this paper.

3. How does this relate to how a person rides a bicycle?

4. How is the center of gravity important in building an airplane? On the back of this paper, draw an illustration depicting the center of gravity of an airplane.

## Dayton Aviation Heritage National Historical Park

### GENERAL INFORMATION

The park commemorates the legacy of three exceptional men — Wilbur Wright, Orville Wright, and Paul Laurence Dunbar — and their work in the Miami Valley. It is comprised of four non-contiguous sites in the Dayton area. Each site is managed independently and needs to be contacted separately for field trips.

**The Wright Cycle Company Complex  
16 South Williams  
Phone (937) 225-7705; Fax (937) 222-4512  
[www.nps.gov/daav/](http://www.nps.gov/daav/)**

The Wright brothers operated their bicycle manufacturing and printing businesses at this site from 1895 to 1897. It is in this building that they began to consider the possibilities of powered flight. No admission fee.

#### *Hours of Operation*

8:30 to 5:00 daily; except Thanksgiving, Christmas and New Year's Day.

**Huffman Prairie Flying Field and  
Interpretive Center  
Wright Patterson Air Force Base  
Phone (937) 425-0008; Fax (937) 425-0011**

The Wrights refined their machine and their flying techniques at this field after their first successful flights at Kitty Hawk, NC. This location also became the base of The Wright Company School of Aviation, the world's first permanent flying school, and The Wright exhibition team. The Interpretive Center continues the story of the Wright brothers in Dayton. No admission fee.

#### *Hours of Operation*

Flying Field - Daylight hours when the base is open to the public.  
Interpretive Center – 8:30 to 5:00 daily; except Thanksgiving, Christmas and New Year's Day.

**Wright Brothers Aviation Center  
Dayton History at Carillon Park  
1000 Carillon Boulevard  
Phone (937) 293-2841; Fax (937) 293-5798  
[www.carillonpark.org](http://www.carillonpark.org)**

The 1905 Wright Flyer III is on exhibit at the John W. Berry, Sr. Wright Brothers Aviation Center. It is the world's first practical airplane. There is an admission fee for the park.

#### *Hours of Operation*

9:30 to 5:00 daily; except Thanksgiving, Christmas and New Year's Day.

**Paul Laurence Dunbar State  
Memorial  
219 N. Paul Laurence Dunbar Street  
Phone (937) 224-7061; Fax (937) 224-4256  
[www.ohiohistory.org/places/dunbar/](http://www.ohiohistory.org/places/dunbar/)**

Dunbar purchased this house for his mother and lived in it from 1902 until his death in 1906. It is at this site that he completed his final works.  
There is an admission fee for the site.

#### *Hours of Operation*

Memorial Day to Labor Day  
Wednesday to Saturday 9:00 to 5:00  
Sunday noon to 5:00

Labor Day to November  
Saturday and Sunday 9:30 to 4:30

November to April  
Closed

April to Memorial Day  
Saturday and Sunday 9:00 to 5:00

Dayton Daily News

