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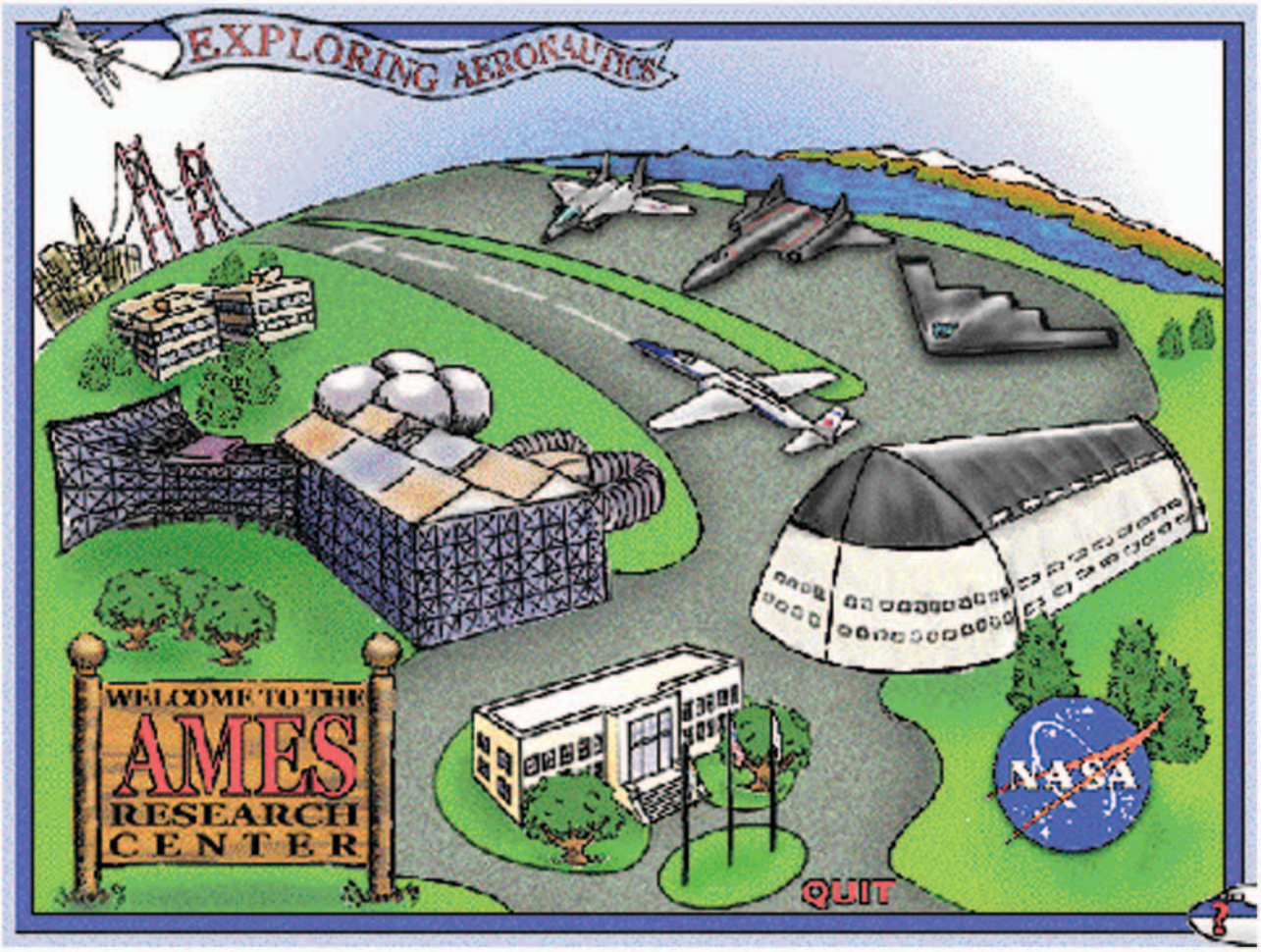
Exploring Aeronautics: Countdown to Flight Educator Guide

A Supplemental Educator Guide with Activities in Aeronautics and Language Arts featuring the book "Countdown to Flight"



To accompany Exploring Aeronautics CD-ROM

aero-nau-tics \-iks\ n pl but sing in constr **1**: a science of dealing with the operation of aircraft **2**: the art or science of flight

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Exploring Aeronautics: Countdown to Flight Educator Guide

To accompany Exploring Aeronautics CD-ROM

National Aeronautics and Space Administration
Office of Education

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Table of Contents

Into Activities

Student Activity Sheet: "And I Quote...." 10
Student Activity Sheet: "And I Quote...." Discussion Key 11
Student Activity Sheet: Circles of Knowledge 12
Student Activity Sheet: Circles of Knowledge Answer Key Example 13
Student Activity Sheet: The Beginnings of Aeronautical Knowledge 14
Student Activity Sheet: The Beginnings of Aeronautical Knowledge Answer Key 15

Through Activities

Student Activity Sheet: Important Dates in the Lives of the Wright Brothers 19
Student Activity Sheet: Important Dates in the Lives of the Wright Brothers - Answer Key 20
Vocabulary List Chapter 1 The Wright Brothers 23
Vocabulary List Chapter 2 Five Years to Flight: 1899 24
Vocabulary List Chapter 3 Four Years to Flight: 1900 25
Vocabulary List Chapter 4 Three Years to Flight: 1901 26
Vocabulary List Chapter 5 Two Years to Flight: 1902 27
Vocabulary List Chapter 6 One Year to Flight: 1903 28
Vocabulary Activity 1: Vocabulary Cards 29
Vocabulary Activity 2: Visual Vocabulary 30
Vocabulary Activity 3: Aeronautical Vocabulary Crossword (Chapter 2) 31
Vocabulary Activity 4: Aeronautical Vocabulary Crossword (Chapters 4 - 6) 34
Student Activity Sheets: Comprehension Questions
- Chapter 1: The Wright Brothers 37
- Chapter 1: The Wright Brothers - Answer Key 39
- Chapter 2: Five Years to Flight: 1899 42
- Chapter 2: Five Years to Flight: 1899 - Answer Key 44
- Chapter 3: Four Years to Flight: 1900 48
- Chapter 3: Four Years to Flight: 1900 - Answer Key 50
- Chapter 4: Three Years to Flight: 1901 52
- Chapter 4: Three Years to Flight: 1901 - Answer Key 53
- Chapter 5: Two Years to Flight: 1902 55
- Chapter 5: Two Years to Flight: 1902 - Answer Key 56
- Chapter 6: One Year to Flight: 1903 58
- Chapter 6: One Year to Flight: 1903 - Answer Key 61
- *Afterword* 64
- *Afterword - Answer Key* 65

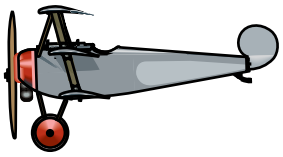
Student Activity Sheet: Design a Billboard 66
Student Activity Sheet: Letter from Lorin 67
Student Activity Sheet: Propeller Motion 68
Student Activity Sheet: Newspaper Article 69
Writing Experience: Writing a Newspaper Article 70
Writing Experience: Writing a Newspaper Article - Example 71
Writing Experience: Write Your Own Newspaper Article 72

Beyond Activities

Student Activity Sheet: A Moment in Time 76
Student Activity Sheet: Evolution of an Idea 77
Student Activity Sheet: Interview with the Brothers 78
Student Activity Sheet: Solving the Problems of Flight 79
Student Activity Sheet: Writing A Ballad 80
Bleriot's Dream 81
Student Activity Sheet: Writing a Ballad 82

References to Aeronautical Concepts Presented in Countdown to Flight! 83

EDCATS Educator Reply Card



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Countdown to Flight!

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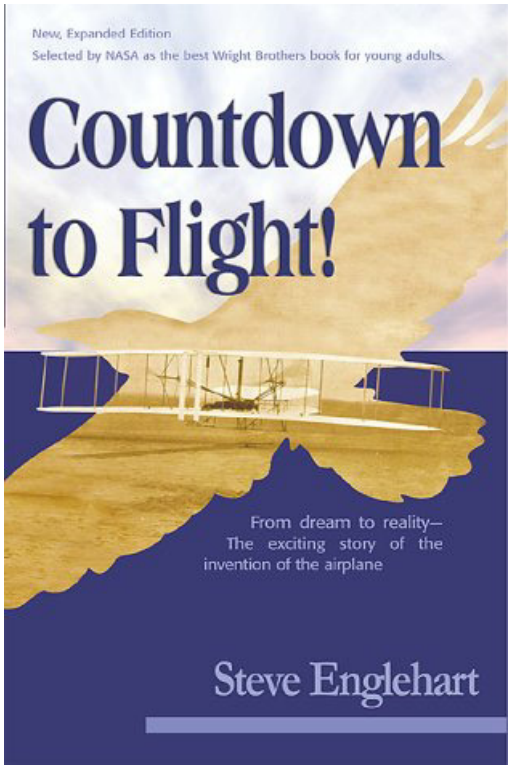


Description

From dream to reality—This is an exciting story of the invention of the airplane. The story focuses on the lives of Orville and Wilbur Wright and their remarkable work of creating a heavier-than-air, powered aircraft that could be successfully controlled during all aspects of flight. The book uses aeronautical terminology and discusses research by the brothers' contemporaries to tell a complete story about the invention of the airplane.

INTO ACTIVITIES

Into Activities

1. Activity Sheet: "And I Quote...."

   Review the quote from the Preface on page 1 of the book, and discuss the idea that technology has expanded so rapidly that many things that were once thought impossible are now a part of our everyday lives.

2. Activity Sheet: Circle of Knowledge

   Using the "Circle of Knowledge" Guidesheet have students in small groups record what they know about the Wright Brothers. Ask them to be as specific as they can. Then, have them formulate questions they have about the Wright Brothers' work in aeronautics.

3. Activity Sheet: The Beginnings of Aeronautical Knowledge

   Review the "History" from The Resource section of the CD-ROM **Exploring Aeronautics** up to the Wright Brothers' entry pre-1899. This is to set the stage for what their predecessors had accomplished up to that time. Using the student guidesheet "The Beginnings of Aeronautical Knowledge", have students in a small-group setting record what was known about flight up to that time. Next, have them complete the second section of the guidesheet and record what knowledge was needed and not yet discovered, in order for powered, sustained flight to be achieved.

Student Activity Sheet: "And I Quote...."

Directions: Begin by reading page 1 of the Preface from the book Countdown to Flight! List below four technological breakthroughs that have happened since 1900 that most people would not have thought would ever have happened. Explain why you think people thought they would never happen.

1. Technological Breakthrough:

   Reason for Disbelief:

2. Technological Breakthrough:

   Reason for Disbelief:

3. Technological Breakthrough:

   Reason for Disbelief:

4. Technological Breakthrough:

   Reason for Disbelief:

Student Activity Sheet: "And I Quote...."

Discussion Key

Directions: Begin by reading page 1 of the Preface from the book Countdown to Flight! List below four technological breakthroughs that have happened since 1900 that most would not have thought would ever have happened. Explain why you think people thought they would never happen.

1. Technological Breakthrough: *Sending people to the moon*

   Reason for Disbelief: *We had just started to fly in 1903 so it would probably take another hundred or two hundred years before we could figure out how to rocket to the moon*

2. Technological Breakthrough: *Telephones in our cars*

   Reason for Disbelief: *Telephones earlier had to be connected to wires. You couldn't put a phone attached to a wire in your car and drive around with it.*

3. Technological Breakthrough: *Laptop computers*

   Reason for Disbelief: *Who could imagine that we would be able to communicate from a tiny portable computer.*

4. Technological Breakthrough: *Satellite dishes for television*

   Reason for Disbelief: *Why would anyone want more than five TV stations anyway? We are all so far apart, how could we possibly communicate over such a long distance? What is a satellite anyway?*

Student Activity Sheet: Circles of Knowledge

Directions: In the top circle on the left, record three facts you know about the Wright Brothers and their work. In the top circle on the right, write down three questions about the Wright Brothers' aeronautical work that you would like to have answered by the time you've completed reading the book, Countdown to Flight! As you read through the novel, complete your Circles of Knowledge by answering each question in the lower circle.

3 Facts I Know

3 Questions I Want Answered

Answers to My Questions

Student Activity Sheet: Circles of Knowledge

Answer Key Example

Directions: In the top circle on the left, record three facts you know about the Wright Brothers and their work. In the top circle on the right, write down three questions about the Wright Brothers' aeronautical work that you would like to have answered by the time you've completed reading the book, Countdown to Flight! As you read through the novel, complete your Circles of Knowledge by answering each question in the lower circle.

Possible Responses

3 Facts I Know

1. The brothers used their mechanical knowledge and experience to design aircraft.
2. The brothers flew kites to help them understand how to control the aircraft during flight.
3. The brothers understood the basic forces of flight: lift, drag, thrust, weight.

3 Questions I Want Answered

1. What kind of experiments did they do to test their ideas?
2. Why did they pick Kitty Hawk as the place to fly?
3. What kind of problems did they have to solve before they could start designing and flying their aircraft?

Answers to My Questions

1. They constructed their own wind tunnel to test airfoil shapes and record their data. They tested their designs as large kites before they made gliders.
2. They picked Kitty Hawk for three reasons: strong and steady winds; privacy (not a well settled or public place); a soft place to land (sand and/or water).
3. What kind of camber should the wings have to generate the greatest amount of lift; what kind of control surfaces were needed to control it in the air; what kind of engine (power, size shape) would be best to power the aircraft.

Student Activity Sheet: The Beginnings of Aeronautical Knowledge

Directions: Using the "History" subsection of the CD-ROM **Exploring Aeronautics**, find out what was known about flight before 1899. List those facts in the top box. In the lower box, list what knowledge was needed to achieve sustained, powered flight.

Aeronautical Knowledge pre-1899

Aeronautical Knowledge Needed

Student Activity Sheet: The Beginnings of Aeronautical Knowledge

Answer Key

Directions: Using the "History" subsection of the CD-ROM **Exploring Aeronautics**, find out what was known about flight before 1899. List those facts in the top box. In the lower box, list what knowledge was needed to achieve sustained, powered flight.

Aeronautical Knowledge pre-1899

- Newton's Third Law: Every action has an equal and opposite reaction; explains thrust (Newton)
- Bernoulli's Principle explains the difference in air pressure between faster and slower moving air (Bernoulli)
- Importance of control surfaces on wings and tail section (Cayley)
- Importance of camber to lift (Wenham)
- Upward tilt of wing (dihedral angle) gives greater stability during flight (Penaud)
- Adapt bird wings for human flight (Lilienthal)
- Box kite design gives greater lift (Hargrave)
- Curved surface of wings gives greater lift (Phillips)
- Stronger wing design gives greater stability to gliders (Chanute)

Needed Aeronautical Knowledge

- small, lightweight, yet powerful engine
- better control surfaces so the airplane could turn
- wing size in relationship to weight of airplane, passengers and cargo
- how to keep the airplane stable during changes in wind or airflow
- which wing shapes give the greatest amount of lift and the least amount of drag
- how to control the pressure of air moving along the wings to maintain front-to-back equilibrium
- how to maintain side-to-side equilibrium ("wingwarping")
- how to maintain the right amount of thrust to keep the airplane in the air during all kinds of manuevers

THROUGH ACTIVITIES

Through Activities

1. Activity Sheet: Important Dates in the Lives of the Wright Brothers

   Distribute the Activity Sheet "Important Dates in the Lives of the Wright Brothers." Have students record the important events and their corresponding dates on this sheet as they read through the book. Emphasize that they need to state the scientific connection on the sheet. In other words, "It was important to the development of flight because...."

2. Activity Sheets: Vocabulary Lists and Activity Sheets

   See the Vocabulary section on pages 23 - 28 of this educator guide for vocabulary words listed by appearance (per chapter).

3. Activity Sheets: Comprehension Questions

   See the Comprehension Questions section on pages 37 - 65 of this instructional guide for chapter by chapter worksheets of the comprehension questions, followed by the answer keys.

4. Activity Sheet: Design a Billboard

   Have the students pretend they are the publicity agents for the Wright Brothers. They are trying to generate excitement around the latest attempt at powered flight. Design a billboard announcing the attempt at powered flight by the Wright Brothers at Kitty Hawk.

5. Activity Sheet: Letter from Lorin

   Pretend you are Lorin Wright (Orville and Wilbur's older brother) joining your brothers at Kitty Hawk for the first time in 1902. Write a letter home to your sister Katharine describing what you see.

Through Activities (continued)

6. Activity Sheet: Propeller Motion

   Using a diagram, describe how a propeller creates forward motion.

7. Activity Sheet: Newspaper Article

   Have the students pretend they are newspaper reporters and have witnessed the first successful flight of a powered aircraft by the Wright Brothers at Kitty Hawk. Write a newspaper article describing this event.

Student Activity Sheet: Important Dates in the Lives of the Wright Brothers

Directions: As you read the novel Countdown to Flight! list each important date in the Wright Brothers' quest for flight. Next to the date, tell why that date was important. Perhaps it was the first idea that led to the invention of an important part of the aircraft.

Important Date	Reason for Importance

Student Activity Sheet: Important Dates in the Lives of the Wright Brothers

Answer Key (page 1)

Directions: As you read the novel Countdown to Flight! list each important date in the Wright Brothers' quest for flight. Next to the date, tell why that date was important. Perhaps it was the first idea that led to the invention of an important part of the aircraft.

Important Date	Reason for Importance
1890	The brothers' father gives them a flying toy made by the Frenchman, Penaud. It is their first exposure to a winged craft and it sparks their imaginations.
August 1896	The brothers read about Lilienthal's death and discuss his work and research on flight. This is when the first seeds of how to fly were planted in their minds.
June 1899	Wilbur writes a letter to the Smithsonian Institution, asking for research information about flight. This forms the basis of their design.
May 1900	Wilbur begins corresponding with Octave Chanute who shared research information he had been gathering about flight. This gave the brothers someone with whom they could discuss aeronautical ideas.
July 1899	Wilbur's observations of how birds use their wings during turbulence give him the idea of "wing warping." He successfully tries out the theory on a biplane kite.

Student Activity Sheet: Important Dates in the Lives of the Wright Brothers

Answer Key (page 2)

Directions: As you read the novel Countdown to Flight! list each important date in the Wright Brothers' quest for flight. Next to the date, tell why that date was important. Perhaps it was the first idea that led to the invention of an important part of the aircraft.

Important Date	Reason for Importance
October 1900	The brothers fly their first glider at Kitty Hawk where they are baffled by a problem with the center of air pressure and how unstable it is. This causes them to redesign the wings' horizontal rudders to a proper size and shape to counterbalance the changing center of air pressure on the wings.
August 1901	Although they had broken the distance for glider flight carrying humans, they are still confounded by the problem of control during turning (drag caused the aircraft to slip sideways and lose control). This inspires them to create a wind tunnel with which to test wing theories.
November 1901	The brothers create their own wind tunnel to test the effectiveness of different types of wing camber on lift and drag.
September 1902	Orville unexpectedly discovers the stalling angle of wings.
October 1902	Trouble with "tailspin" prompts the brothers to redesign the vertical rudder that features one large movable flap.

Student Activity Sheet: Important Dates in the Lives of the Wright Brothers

Answer Key (page 3)

Directions: As you read the novel Countdown to Flight! list each important date in the Wright Brothers' quest for flight. Next to the date, tell why that date was important. Perhaps it was the first idea that led to the invention of an important part of the aircraft.

Important Date	Reason for Importance
February 1903	An engine especially designed for their aircraft is made by the brothers and their mechanic, Charlie Taylor. Previously there were no engines small, light or powerful enough to be used for aircraft. The brothers design one just for this purpose. Propellers are also designed. And just like the engine, the brothers do the original research and experiments to design the best type of propellers.
November 1903	While testing the engine, the drive shafts are damaged. Even after repairing the drive shafts, the brothers realize that the shafts have to be made of steel, not wood. This makes the shafts stronger.
December 1903	They make four powered flights.
1905	Wilbur stays airborne for 38 minutes, flying 24 miles.
1908	Orville flies for over an hour with a passenger. They also sign a contract with the governments of the U.S. and France to manufacture aircraft.

Vocabulary List (by chapters)

Chapter 1 *The Wright Brothers*

* denotes aeronautical term

page	vocabulary word
3	succumbed
	occasionally
	relocate(d)
5	mischievous
	impulsive
	articulate
6	palpitations
	prescribed
	infirmities
	recuperation
	tuberculosis
	frequently
7	absolutely
	preceded
	confidante
	apprentice
	destined
	tirelessly
	researching
8	rapport
	fierce
	agile
	eclipsing
9	generated
	overwhelmed
	delirious
	engineer
	intrigued
	bedridden

Vocabulary List (by chapters)
Chapter 2 *Five Years to Flight: 1899*

page	vocabulary word
14	retrospect
	association
	besieged
	plundered
	speculation
15	disregard
	imprisonment
	plummeted
16	ornithopter(s)*
	experimentation
17	pressure
	propellers*
	aviation*
18	gust
	equilibrium
19	corresponded
	aeronautical*
	barometric pressure*
	altitude(s)*
	speculation
20	sustain(ed)
	wingspan*
	ambitious
21	progress(ed)
	quest
	synchronicity
	systematic experiments
	undertook (undertake)
22	observant
	trial and error
	methodical
	balance
	horizontal
	rudder*
	elevator*
	nosedive*
	parachute
	center of gravity*
	devised
	observation(s)
	wing warping*
	manipulate(d)
	counterbalance
23	biplane*
	crisscross(ing)
	leading edge*
	achieve(d)
	stability*
24	seasonal
	minimize
	compiling (compile)
	procedure(s)
	test site

Vocabulary List (by chapters)
Chapter 3 *Four Years to Flight: 1900*

page	vocabulary word
25	severity
	conceive
	fortunate
	advice
26	preliminary
	constant
	isolated
	obstruction(s)
	assembling (assemble)
	sateen fabric
27	harrowing
	resewn
	adjusted
	hospitable
28	reassure
29	encounter(ed)
	angle
	square footage
	curvature
	baffle(d)
30	parallel
	center of pressure*
	horizon
	prone position
31	tremendous
	analyze(d)
	correspondence
	advances in the field
	request(ed)
	reluctant
	inasmuch

Vocabulary List (by chapters)
Chapter 4 *Three Years to Flight: 1901*

page	vocabulary word
33	income
	animated discussion
	anemometer*
34	collaboration
	recognition
	tar paper
	pine planks
35	surface area
	previous
	propose(d)
	deflected
	configuration
	stall*
36	compensate
	minimize
	alter(ed)
	wind resistance*
	thereafter
37	genuinely
	resistance*
	confound(ed)
38	prediction
	distinguish(ed)
39	invigorate(d)
	ratio
	angle of exposure*
	airfoils*
	configuration
	internal combustion engine
	approximately
	speculation

Vocabulary List (by chapters)
Chapter 5 *Two Years to Flight: 1902*

page	vocabulary word
41	motivate(d)
	cutting edge
	mercenary
	interfere
42	anxious
	prefer(red)
	incessant
	snugly
43	instinctive
	vertical
44	stall*
	prowl(ed)
	dispose(d)
	vengeance
	impudence
45	assist
	tailspin*
	bank(ing)*
46	refining (refine)
47	aileron*
	alter(ed)
	overcome
48	rigid
	immovable
	withstand
	vibration(s)

Vocabulary List (by chapters)

Chapter 6 *One Year to Flight: 1903*

page	vocabulary word
49	stable
	controllable
	accommodate
	cylinder
	horsepower
50	strut
	crankcase
	thrust*
	exist(ed)
	calculations
	wind tunnel*
	accelerate(s)
	decrease(s)
	determine(d)
	scientific formula
	compile
	effective
	equations
51	daunting
	precise
	rotate(d)
	three-dimensional
	distract(ed)
	current
	crate(d)
52	climatic
	assemble(d)
53	catapult(ing)
	aerodrome*
	dismay(ed)
	eminent
	ridicule
54	bracing (brace)
	ventilation
55	dismay
	forego
	drive shaft
	sprockets
	enthusiastic
	symmetrical
	compensate
	position(ed)
56	skids*
	complex
	velocity
	takeoff*
	trolley
	adapted
	runners
57	monorail
	non-functional
	extremely
58	worsening
	determine(d)
59	launch site*
	stationary
60	restraining rope
	tolerate
	spyglass
61	tripod
	onlookers

Vocabulary Activity 1
Vocabulary Cards

Directions: For each of the vocabulary words assigned by your teacher, complete a Vocabulary Card. Make sure that you include all the information requested below, and on the back use the word in a well written sentence. It is important that your sentences reflect the meaning of the word.

_____
vocabulary word

_____ _____
page # part of speech

sentence from chapter: _____

_____

_____

dictionary definition: _____

_____

On the back of your card use the word in a sentence

Vocabulary Activity 2
Visual Vocabulary

Directions: Choose _____ of the vocabulary words from Chapter _____ of the book Countdown to Flight! and create a visual definition for each word. These drawings should reflect the meaning of each word. The drawings should also be simple, yet offer a memory clue to help you connect to each word's meaning.

Look over each example given below and discuss how the meaning of the word is reflected in the simple drawing.

PALTAtion

Plum
m
e
t
e
d

Overwhelmed

Vocabulary Activity 3
Aeronautical Vocabulary Crossword
Countdown to Flight! Chapter 2

Directions: Use the clues below to complete the crossword puzzle found on the next page. Remember these are aeronautical vocabulary words only.

ACROSS

1. an airfoil that gives an airplane thrust and can push or pull the airplane through the air

3. the length of the wings from tip to tip

4. the ability of an airplane to remain stable during flight

7. a control surface that enables the pitch motion

9. an airplane with two sets of wings

DOWN

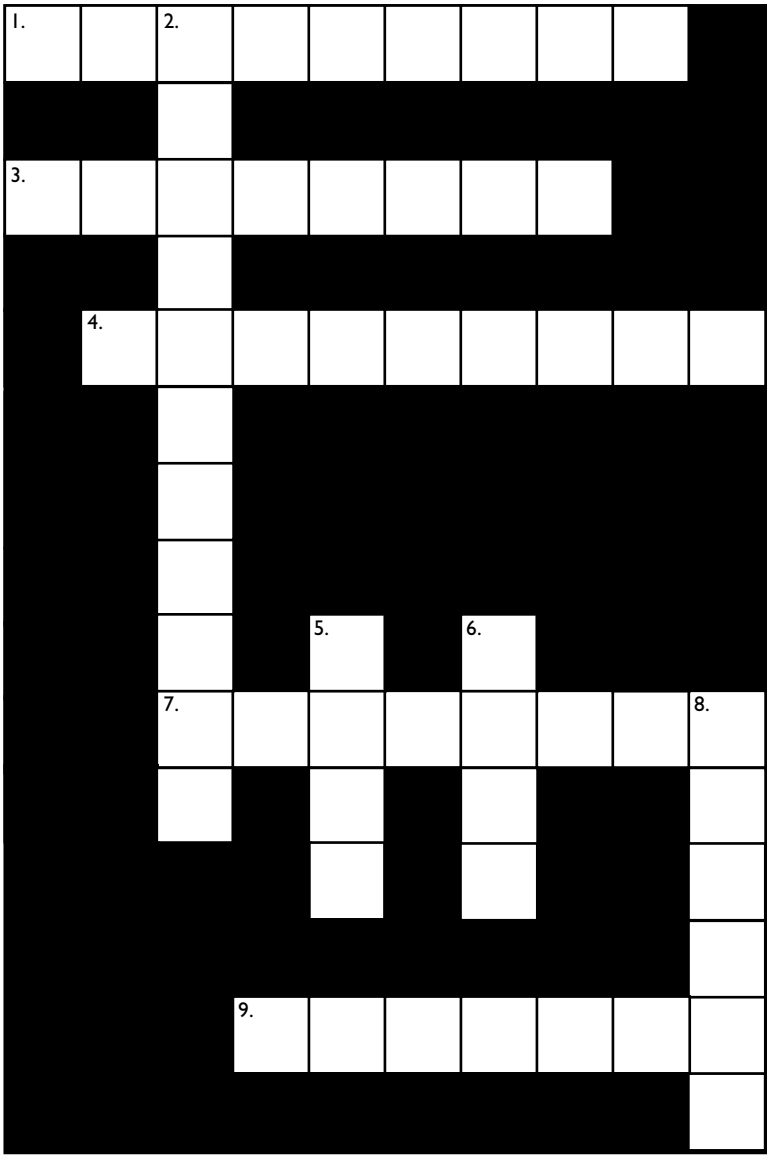
2. early flying machines which used a flapping wing approach

5. the front edge of a wing or ——ing edge

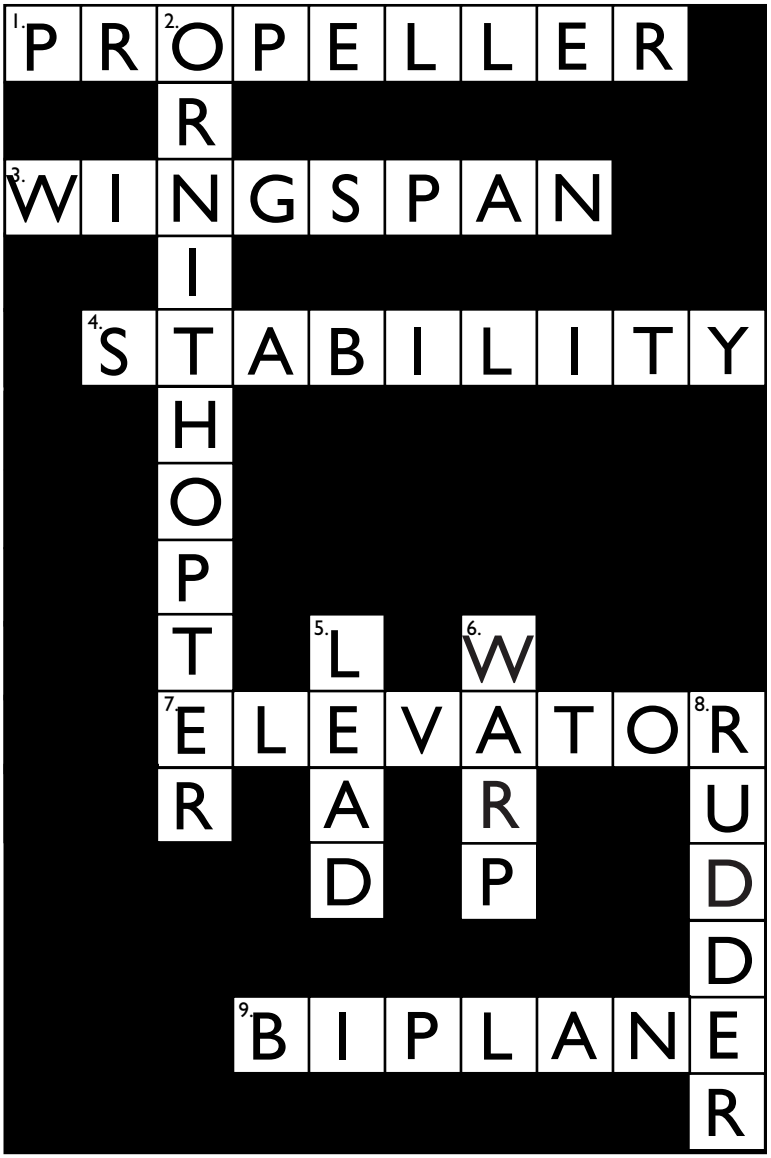
6. the technique used by the Wright Brothers to control their aircraft, wing ——ing

8. a control surface that enables the yaw motion

Vocabulary Activity 3
Aeronautical Vocabulary Crossword
Chapter 2



Vocabulary Activity 3
Aeronautical Vocabulary Crossword
Chapter 2



Vocabulary Activity 4
Aeronautical Vocabulary Crossword
Countdown to Flight! Chapters 4 - 6

Directions: Use the clues below to complete the crossword puzzle found on the next page. Remember these are aeronautical vocabulary words only.

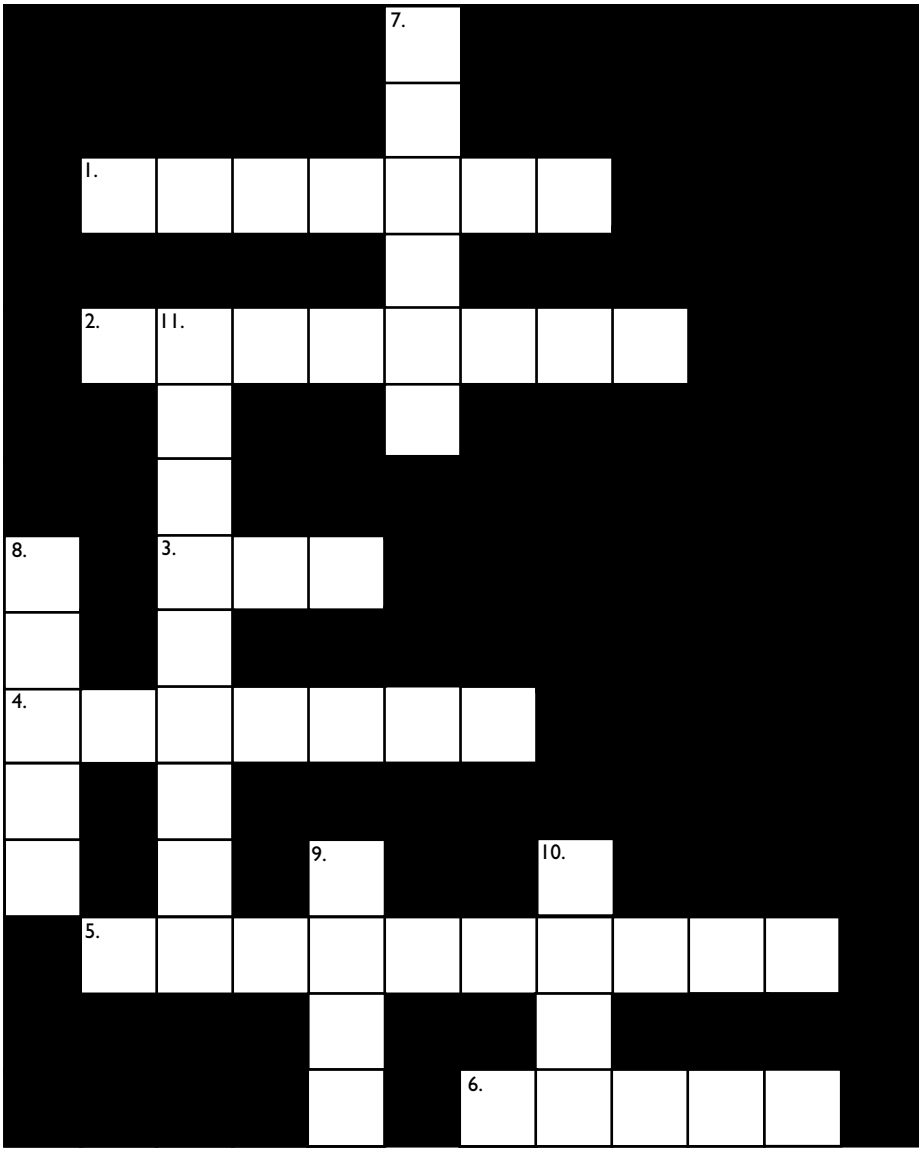
ACROSS

1. a control surface which enables the roll motion
2. an uncontrollable spin
3. to launch an airplane into the air is called take—
4. the shape of a wing that helps to create lift
5. another aeronautical word for drag
6. ski-type landing gear

DOWN

7. one of the four forces that act on an airplane
8. occurs when the angle of attack is too steep to generate lift
9. a tunnel or tube through which air is blown around a model to test its design is called a —— tunnel
10. to roll an airplane slightly in order to turn
11. Samuel Langley's name for an airplane

Vocabulary Activity 4
Aeronautical Vocabulary Crossword
Countdown to Flight! Chapters 4 - 6



Vocabulary Activity 4
Aeronautical Vocabulary Crossword
Countdown to Flight! Chapters 4 - 6

Comprehension Questions
Chapter 1: *The Wright Brothers*

Directions: After reading Chapter 1, *The Wright Brothers,* answer each question using complete sentences. Back up (justify) your answers by using information from the book.

1. In your own words, tell about each member of the Wright family.

2. What did Milton Wright (father) give the brothers that fascinated them so?

3. What did the brothers do with that gift?

4. In your own words, describe Orville Wright.

5. In your own words, describe Wilbur Wright.

6. Wilbur had planned to go to college. What happened that changed his plans?

Comprehension Questions
Chapter 1: *The Wright Brothers* (cont.)

7. What happened to the brothers' mother?

8. How do you think this affected Wilbur?

9. After this tragedy, how did the family's life change?

10. What was Orville's interest between 1884 - 1892?

11. What invention next attracted their attention?

12. Where did this new invention lead the brothers?

13. What two life-changing events happened at the same time?

Comprehension Questions
Chapter 1: *The Wright Brothers*
Answer Key

1. In your own words, tell about each member of the Wright family.

Father - Milton Wright, Protestant Minister
Mother - Susan Koerner Wright, homemaker
Siblings - Oldest: Older Brother #1
Older brother #2 (Lorin)
Wilbur born April 16, 1867
Twins; one died at birth, the other died a month later
Orville born August 19, 1871
Sister: Katharine
The family moved occasionally and eventually settled in Dayton, Ohio.

2. What did Milton Wright (father) give the brothers that fascinated them so?

He brought home a flying toy that was a rubberband-powered "helicoptere" that was made by Alphonse Penaud of France.

3. What did the brothers do with the gift?

They played with it for hours and created their own version of it. They probably wondered about how it worked, took it apart, examined it, maybe even improved it, and then put it back together.

4. In your own words, describe Orville.

A mischievous youngster who would get suspended from school because of pranks. He was good at learning and teaching himself by going to the library and doing research. The author describes him as impulsive, optimistic, energetic and shy. He also had a good memory. He was also nervous when speaking in public.

5. In your own words, describe Wilbur.

He was articulate (well spoken). He did math problems differently than the teacher taught him to. He was a fine athlete who did well at running.

6. Wilbur had planned to go to college. What happened that changed his plans?

He was struck hard in the face during an ice-skating game. It was not a major blow, but it evidently shocked his system to the point that he suffered from heart palpitations and had digestion problems. He was confined to bed for nearly two years before the doctor said he was cured. He became depressed because he lost his chance to go to college, so he spent another year reading and educating himself at home.

7. What happened to the brothers' mother?

She developed tuberculosis and died.

8. How do you think this affected Wilbur?

He cared for his mother, which possibly showed that he could overcome the setback and live his own life. It probably forced him out of his depression and got him back into living life by working with his father.

9. After this tragedy how did the family's life change?

Katharine, at the age of fifteen, took on the job of running the house. She was, however, the only one of the three younger siblings to graduate from college. She was a great support to Wilbur and Orville. She encouraged them and became their confidante.

10. What was Orville's interest between 1884 - 1892?

Orville got a printing press, and with a friend of his, started a school newspaper that eventually (after his friend lost interest and his brother Wilbur joined in) led to a daily town newspaper. Their enterprise expanded into a print shop.

11. What invention next attracted their attention?

The bicycle caught their attention. They first rode one for pleasure, but then they taught themselves how it worked and how to repair it.

12. Where did this new invention lead the brothers?

It led them to learn how bicycles worked and how to repair them. They then decided to open a second business: a bicycle repair shop. The shop expanded quickly and they soon designed their own bicycle.

13. What two life-changing events happened at the same time?

Orville came down with Typhoid Fever. Wilbur stayed by his bedside to watch after him (with Katharine's help). While by Orville's side, Wilbur had time to read the news and reflect on the tragic accident which killed a German engineer, Otto Lilienthal, who was experimenting with flying gliders. They spent some time discussing the possibility of flight. Being mechanics, they found it very interesting. After Orville got well, they returned to work at the bicycle shop.

Comprehension Questions
Chapter 2: *Five Years to Flight: 1899*

Directions: After reading Chapter 2, *Five Years to Flight: 1899,* answer each question using complete sentences. Back up your answers by using information from the book.

1. How did Wilbur get information about flight? How do we go about finding information on flight today?

2. Why do you think Wilbur suddenly decided to head in a new direction?

3. On a separate piece of paper, create a chart that summarizes each of the 13 aeronautical entries mentioned by the author. Use the headings below to help plan your chart.

   Individual Time Period Place Achievement

4. After the Wright Brothers read through all the material, what three problems did they decide needed to be solved in order to have a successful flight? List them.

5. Which one of the three problems seemed to the brothers to be the toughest to solve? Why do you think it was tough to solve?

Comprehension Questions
Chapter 2: *Five Years to Flight: 1899* (cont.)

6. How did the brothers go about solving the problems?

7. What two problems did they work on first, and what were the solutions for each?

8. How did they try out their ideas?

9. What kind of test site did the brothers look for? Where did they go to find this information?

Comprehension Questions
Chapter 2: *Five Years to Flight: 1899*

Answer Key

1. How did Wilbur get information about flight?

   He wrote a letter to The Smithsonian Institution requesting all the information they had acquired on flight.

   How would we go about finding information on flight today?

   We could use these resources:
   library, Internet or Web, Flight Associations or agencies (FAA or NASA), books, magazines, newspapers, videos, CD-ROMs.

2. Why do you think Wilbur suddenly decided to head in a new direction?

   Perhaps he was bored with the cycle shop and needed a change or a new problem to solve or challenge in his life.

3. On a separate piece of paper, create a chart that summarizes each of the 13 aeronautical entries mentioned by the author. Use the headings below to help plan your chart. *(Please see following page for chart)*

Individual	Time Period	Place	Achievement
Daedalus	*legend*	*Greece*	*made wings of feather and wax and flew, but crashed*
Chinese	*500 BC*	*China*	*propeller driven toys kites*
R. Bacon	*1200*	*England*	*wrote about ornithopters (flapping wing devices)*
St. Joseph	*1600*	*Italy*	*said to fly using spiritual powers*
da Vinci	*1300*	*Italy*	*designed plans for flying machine*
Danti	*1490*	*Italy*	*tower jumper*
Oliver	*1000*	*England*	*tower jumper*
Bocqueville	*1742*	*France*	*human glider*
Montgolfier	*1783*	*France*	*hot air balloon*
Cayley	*1804*	*England*	*glider*
Henson/ Stringfellow	*1844*	*England*	*fixed wing flying machine with propellers-(model)*
Stringfellow	*1844*	*England*	*improved the model above, but made it smaller*
Lilienthal	*1890s*	*German*	*man-carrying gliders*
Chanute	*1890s*	*US*	*designed gliders and wrote a book which compiled all aeronautical research acquired*
Hargrave	*1893*	*Australian*	*developed box kite used to research aircraft wings*
Langley	*1896*	*US*	*built scale models of flying machines (aerodomes)*

4. After the Wright Brothers read through all the material, what three problems did they decide needed to be solved in order to have a successful flight? List them.

   1. Wings are needed to lift an airplane into the air.
   2. An engine had to move the airplane through the air once it was airborne.
   3. The pilot needed to be able to control the aircraft's movement once it was airborne.

5. Which one of the three problems seemed to the brothers to be the toughest to solve? Why do you think it was so tough to solve?

   The problem of control. No one else seemed to have designed a way to control an aircraft, because most of the inventors of the time were still trying to get an aircraft to fly.

6. How did the brothers go about solving the problems?

   They created systematic experiments— each experiment led to another. They were observant and kept detailed records of the results. They did not want to experiment by trial and error.

7. What two problems did they work on first and what were the solutions for each?

   Problem 1: *They first wanted to figure out how to control the aircraft's balance so that it would not tip and crash in a gust of wind.*

   Solution: *To balance the wing lift they put a smaller, flat horizontal flap in front of the wings which could be raised and lowered. They called it a "horizontal rudder" (it was used like the present-day control surface: elevator). It controlled the pressure of air moving along the wings to keep the pressure balanced from front to back.*

   Problem 2: *Side-to-side balance of the aircraft.*

   Solution: *Twist the wingtips so that one would twist upward and the other would twist downward to counterbalance any change in the airflow. They called this "wing warping."*

8. How did they try out their ideas?

They created a boxkite structure with bamboo struts and wires attached to the wing tips and flew it like a kite. They manipulated the wingtips with the wires to control and balance the kite.

9. What kind of test site did the brothers look for? Where did they go to find this information?

test site: steady winds and smooth, treeless surface

source: Weather Bureau

Comprehension Questions
Chapter 3: *Four Years to Flight: 1900*

Directions: After reading chapter 3, *Four Years to Flight: 1900,* answer each question using complete sentences. Back up your answers by using information from the book.

1. What did Octave Chanute believe about progress in the quest for flight?

2. How did the Brothers decide to pick Kitty Hawk as their test site?

3. What did their first tests at Kitty Hawk reveal to them?

4. How did they solve the problem of the changing center of air pressure?

Comprehension Questions
Chapter 3: *Four Years to Flight: 1900*
(cont.)

5. How did they lower the wind resistance of their aircraft?

6. What did they do with the glider after the trials were over and before they left for home?

7. Why do you think that the brothers did not want Chanute to write about their work in his articles?

Comprehension Questions
Chapter 3: *Four Years to Flight: 1900*

Answer Key

1. What did Octave Chanute believe about progress in the quest for flight?

   He believed that the progress of manned flight would come from many different people working on the problem. He believed that people should work together and share information.

2. How did the brothers decide to pick Kitty Hawk as their test site?

   Chanute suggested a sand hill for launching and attempting flight over water (for a safer, softer landing).

   Out of more than six possible sites the Weather Bureau suggested Kitty Hawk for its steady winds and flat surface. It was also the least populated site, and it was remote, so they would have privacy.

3. What did their first tests at Kitty Hawk reveal to them?

   Design problems:

   1. *angle at which the wing must meet the air*
   2. *the necessary square footage of the wing surface*
   3. *the amount of curvature of the wing*
   4. *the weight a glider could carry at a safe wind speed*
   5. *how to handle a stall (when the lift was suddenly gone)*

4. How did they solve the problem of the changing center of air pressure?

   They needed to work out the right size and shape for the wings' horizontal rudders, so that the rudders could counterbalance the changing center of air pressure on the wings.

Comprehension Questions
Chapter 3: *Four Years to Flight: 1900*

Answer Key (cont.)

5. How did they lower the wind resistance of their aircraft?

   They placed the pilot in a prone or flat position.

6. What did they do with the glider after the trials were over and before they left for home?

   They gave it to some locals (Mr. and Mrs. Tate) to recycle. Mrs. Tate used the material for dresses for her daughters.

7. Why do you think that the brothers did not want Chanute to write about their work in his articles?

   Accept any logical answer. Some possibilities:

   - *they wanted to do more tests before letting people know what they were working on;*
   - *they did not want the attention until they were sure of their work;*
   - *they preferred to work in anonymity so they could accomplish more in less time and not be bothered while doing their work.*

Comprehension Questions
Chapter 4: *Three Years to Flight: 1901*

Directions: After reading Chapter 4, *Three Years to Flight: 1901,* answer each question using complete sentences. Back up your answers by using information from the book.

1. On a separate piece of paper, make a chart that lists the differences between the glider of 1900 and the glider of 1901.

Difference	1900	1901

2. Name the two problems which they were having, and give the solution for each problem.

3. What happened when Wilbur attempted to turn the glider during flight?

4. What did this problem lead them to do next?

5. What do you think the brothers used these experiment results for?

Comprehension Questions
Chapter 4: *Three Years to Flight: 1901*

Answer Key

1. On a separate piece of paper, make a chart that lists the differences between the glider of 1900 and the glider of 1901.

Difference	*1900*	*1901*
wingspan	*16 ft.*	*22 ft.*
wing width	*5 ft.*	*7 ft.*
surface area of wing	*165 sq. ft.*	*308 sq. ft.*
wing curve	*less*	*greater*
leading edge	*sharper*	*blunter*
wing warp	*controlled by hands*	*controlled by feet*
weight	*46 lbs.*	*98 lbs.*
landing gear	*none*	*skids*

2. Name the two problems which they were having, and give the solution for each problem.

Problem: *center of pressure*

Solution: *reduced the curvature of the wings and changed the shape of the leading edge of the wing to lower wind resistance*

Problem: *stalling*

Solution: *do not angle the wing too steeply during slow flight*

Comprehension Questions
Chapter 4: *Three Years to Flight: 1901*
Answer Key

3. What happened when Wilbur attempted to turn the glider during flight?

When he changed the shape of the wing by "wing warping," he created drag, and it slowed the motion of the right wing. The left wing continued to move forward. This caused the glider to slip sideways, and Wilbur lost control.

4. What did this problem lead them to do next?

They realized that they would have to throw out all the mathematical tables and old theories of curvature of the wing and develop new and more accurate tables. They had to devise a way to test wings for the following aspects:

- *length-to-width ratio*
- *the proper curve*
- *shape of the front edge*
- *the correct angle of exposure to the airflow*
- *the center of pressure*

All this led them to design and create their own wind tunnel. It was six feet long and sixteen inches square. It used a small internal combustion engine to turn the fan. It had a small, glass window on the top which allowed the experimenter to view the wing models during the experiment. The Brothers tested about 150 different wing models in their wind tunnel.

5. What do you think the brothers used these experiment results for?

They used their results to develop a mathematical table that would tell them how much lift and drag each wing curve had.

Comprehension Questions
Chapter 5: *Two Years to Flight: 1902*

Directions: After reading Chapter 5, *Two Years to Flight: 1902,* answer each question using complete sentences. Back up your answers by using information from the book.

1. List the changes the brothers made to the glider of 1902.

2. What was the "big problem" of 1902, and how did they solve it?

3. Explain how each movement was now being controlled.

4. What old idea for control was finally "put to rest"?

5. What was the last design change that the brothers made before leaving Kitty Hawk this year? Why did they change it?

Comprehension Questions
Chapter 5: *Two Years to Flight: 1902*

Answer Key

1. List the changes the brothers made to the glider of 1902.

   - *wings were slightly larger in square footage, but longer and narrower (32 ft. by 5 ft.);*
   - *smaller curve which peaked about a third of the way back from the leading edge;*
   - *forward elevator was smaller and shaped like a small wing;*
   - *a hip cradle was added which was connected to the wings and held the pilot snugly into position. This would cause the wings to warp when needed whenever the pilot instinctively moved his body in a reaction to the wing movement;*
   - *added a six-foot vertical, double tail with a fixed rudder to help control the glider in a turn.*

2. What was the "big problem" of 1902, and how did they solve it?

   Problem: *An uncontrollable tailspin would occur whenever the aircraft was put into a sharp turn with a steep banking of the wings.*

   Solution: *Use only one rudder and make it movable. Attach the wing warping wires to the rudder so that the pilot would control them both at the same time.*

3. Explain how each movement was now being controlled.

   pitch *front elevator*

   roll *wing warping*

   yaw *rear vertical rudder*

4. What old idea for control was finally "put to rest"?

   The idea that the pilot could control the aircraft by shifting his/her weight.

Comprehension Questions
Chapter 5: *Two Years to Flight: 1902*
Answer Key (continued)

5. What was the last design change that the Brothers made before leaving Kitty Hawk this year? Why did they change it?

   They made the glider's wings more rigid by making the leading edges of the wings immovable. They would twist only the rear outer edges of the wingtips. They were thinking ahead. They knew that the next step would be to put an engine on their glider. They believed that the wing design change would withstand the engine's vibration better.

Comprehension Questions
Chapter 6: *One Year to Flight: 1903*

Directions: After reading Chapter 6, *One Year to Flight: 1931,* answer each question using complete sentences. Back up your answers by using information from the book.

1. What did the brothers have to design and create before they went back to Kitty Hawk?

2. Explain what propellers are and how propellers work.

3. What new problem had to be solved with propellers?

Comprehension Questions
Chapter 6: *One Year to Flight: 1903*
(continued)

4. What was the design solution for the propeller problem?

5. Why did the brothers want to keep their work on engines and propellers a secret?

6. List the setbacks the brothers encountered during their visit this year to Kitty Hawk.

Comprehension Questions
Chapter 6: *One Year to Flight: 1903*
(continued)

7. The author noted some differences in this engine-bearing aircraft. List these differences below.

8. Describe how the aircraft was launched.

9. How long did Orville keep the *Flyer* up in the air?

10. How far did he fly?

Comprehension Questions
Chapter 6: *One Year to Flight: 1903*

Answer Key

1. What did the brothers have to design and create before they went back to Kitty Hawk?

   They had to design and create an engine light enough and powerful enough to give sufficient thrust to make their "glider-aircraft" fly. They would also have to redesign their glider so that it could accommodate an engine (because it is added weight). They also had to design and create propellers to give the thrust to their aircraft.

2. Explain what propellers are and how propellers work.

   Propellers are airfoils. A turning propeller increases the air pressure behind it. This increase in air pressure behind it pushes the propeller into the lower pressure area in front of the propeller. But as the speed of the forward movement accelerates, the difference between the air pressure in front of the propeller and behind the propeller decreases. This causes the thrust to decrease.

3. What new problem had to be solved with propellers?

   As the speed of the forward movement accelerates, the difference between the air pressure in front of the propeller and behind the propeller decreases. This causes the thrust to decrease. So the brothers had to figure out a way to keep the thrust from decreasing during the forward movement.

   There had been no research done on how propellers can be used to push air, so the brothers had to solve another problem.

4. What was the design solution for the propeller problem?

   They designed two rear-mounted propellers which were connected to the engine by strong, bicycle-type chains. The chains rotated each propeller in opposite directions (to maintain stability and to keep the aircraft from moving in a circle).

Comprehension Questions
Chapter 6: *One Year to Flight: 1903*

Answer Key (continued)

5. Why did the brothers want to keep their work on engines and propellers a secret?

   They did not want to be bothered or distracted by reporters. They wanted to keep people away until they really had a successful, power-driven aircraft.

6. List the setbacks the brothers encountered during their visit this year to Kitty Hawk.

   - *rain;*
   - *more storms with lots of wind and rain;*
   - *during engine testing, the engine motion caused the chains to be jerked around, which yanked the sprockets loose from the shafts and damaged them;*
   - *shafts had to be sent back to Ohio to be repaired;*
   - *during a second testing of the engine with the new shafts, a crack developed, so they needed to make steel shafts instead of wooden shafts;*
   - *Orville returned to Dayton to make the steel shafts.*

7. The author noted some differences in this engine-bearing aircraft. List these differences below.

   - *wingspan* — *40 feet, 4 inches*
   - *wing width* — *6 feet, 6 inches*
   - *total area of wings* — *510 square feet*
   - *wings curved downward so that the tips were 10 inches lower than the central section*
   - *length from nose to tail* — *21 feet, 1 inch*
   - *two skids braced to the upper and lower wing*

Comprehension Questions
Chapter 6: *One Year to Flight: 1903*

Answer Key (continued)

8. Describe how the aircraft was launched.

   It was wheeled from the storage building on a track to the launch site one-fourth of a mile away.

   It was placed on a trolley which was on a track that led from the top of a sand dune down an incline. When ready for takeoff, struts holding up each wing were removed and a person was placed at each wingtip to keep it balanced. The pilot would flip the clip that released the restraining rope. The aircraft would then freely move along the mono-rail and down the sand dune's slope.

9. How long did Orville keep the *Flyer* up in the air?

   Twelve (12) seconds.

10. How far did he fly?

    One hundred and twenty (120) feet.

Comprehension Questions
Afterword

Directions: After reading the *Afterword,* answer each question using complete sentences. Back up your answers by using information from the book.

1. How many flights were flown that day? What was the longest flight?

2. Why do you think their achievement did not get a lot of attention?

3. Give a brief timetable of the Wright Brothers' lives from that point on. Give the year and then briefly describe the event.

4. What happened to the *Kitty Hawk Flyer* after the Wright Brothers were finished using it? (Three things happened to it.)

Comprehension Questions
Afterword
Answer Key

1. How many flights were flown that day? What was the longest flight?

   Four flights were flown, with the longest being flown by Orville a distance of 852 feet for a total time of 59 seconds.

2. Why do you think their achievement did not get a lot of attention?

   They did not have newspaper reporters present at the time it happened, so the story was not witnessed firsthand by a news reporter. They really did not want a lot of attention because they were afraid that someone would copy their work before they could have it patented. So the only message that went out was a garbled telegram transmission which they sent to their father.

3. Give a brief timetable of the Wright Brothers' lives from that point on. Give the year and then briefly describe the event.

Year	Event
1905	*Wilbur flew for 38 minutes and more than 24 miles*
1908	*Orville flew for over an hour with a passenger*
1912	*Wilbur dies from Typhoid fever*
1915	*Orville sold the Wright Company for 1 million dollars*
1948	*Orville dies*

4. What happened to the *Kitty Hawk Flyer* after the Wright Brothers were finished using it?

   It was first exhibited for 20 years in a museum in London. Then it was permanently installed for exhibit in the Smithsonian (Washington, D.C.). A piece of the wing fabric was taken to the moon in 1969 by astronaut Neil Armstrong.

Student Activity Sheet: Design a Billboard

Directions: Pretend you are the publicity agent for the Wright Brothers. You are trying to generate some excitement about their next attempt at powered flight. Design a billboard announcing the event which will take place at Kitty Hawk, North Carolina on December 17, 1903.

Include the following information in your billboard presentation:

- An illustration of what the event might look like
- Who will be there
- Where it will take place
- When it will begin
- What is supposed to happen

Use the box below for the rough draft of your billboard.

Student Activity Sheet: Letter from Lorin

Directions: Pretend you are Lorin Wright (Orville and Wilbur's older brother) joining your brothers at Kitty Hawk for the first time in 1902. Write a letter home to your sister Katharine describing what you see.

Use proper letter writing form. Include an **introductory paragraph** that lets your sister know, in general, how things are there at Kitty Hawk. In the **second paragraph**, describe the geographical setting, as well as the physical accommodations which the brothers have built. In the **third paragraph**, describe what the brothers have accomplished so far and how they feel about their work during this time. In the **final paragraph**, conclude with how you (as Lorin) feel about the work your brothers are doing at Kitty Hawk.

Use the pre-write below to help you organize your thoughts for the letter you will write. After you complete your pre-write, begin writing your letter. Remember to use proper letter writing form.

Paragraph 1: Let your sister know, in general, how things are there.

Paragraph 2: Describe what the area looks like and the camp your brothers have built at Kitty Hawk.

Paragraph 3: Describe what your brothers have accomplished so far and how they feel about their work.

Paragraph 4: Tell Katharine how you (as Lorin) feel about the work your brothers are doing.

Student Activity Sheet: Propeller Motion

Directions: In the novel Countdown to Flight! the author explains how a propeller creates forward motion on an airplane. Create a diagram or series of illustrations and describe in your own words how a propeller creates forward movement. Use page 50 of the novel as one reference. Try to find at least two other references (using other sources) that explain how a propeller works.

Include the following information in your diagram:

- Illustrations that show how the propeller creates forward motion for an airplane (use as many as you need);
- Brief explanations to explain what is happening in each of your drawings;
- Labels on your diagrams.

After you do research, use the space below to create a rough draft of what your drawings will look like.

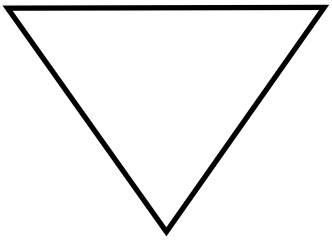
Student Activity Sheet: Newspaper Article

Directions: Pretend you are a newspaper reporter and have just witnessed the historic first, successful flight of a powered aircraft by the Wright Brothers at Kitty Hawk. Write a newspaper article describing the event.

Use the examples found on the following pages to help you hone your skills as a newspaper reporter.

Writing Experience: Writing a Newspaper Article

Newspaper articles require a completely different style of writing from what is used when writing a story. When writing a newspaper article, picture a triangle like the one shown.



The newspaper article has all of the important information in the opening paragraph. This information includes **who**, **what**, **when**, **where**, **why** and **how**. It is written this way because most people do not read an entire newspaper article all the way through. So, newspaper writers put the most important information at the beginning.

A typical newspaper article contains five (5) parts:

Headline: This is a short, attention-getting statement about the event.

Byline: This tells who wrote the story.

Lead paragraph: This has ALL the who, what, when, where, why and how in it. A writer must find the answers to these questions and write them into the opening sentence(s) of the article.

Explanation: After the lead paragraph has been written, the writer must decide what other facts or details the reader might want to know. The writer must make sure that he/she has enough information to answer any important questions a reader might have after reading the headline and the lead paragraph. This section can also include direct quotes from witnesses or bystanders.

Additional Information: This information is the least important. Thus, if the news article is too long for the space it needs to fill, it can be shortened without rewriting any other part. This part can include information about a similar event.

Writing Experience: Writing a Newspaper Article - Example

Below is an example of a newspaper article:

Headline: High flying escape ends in death

Byline: By Susanne Ashby

Lead paragraph: Icarus, son of the famous inventor, Daedalus, plunged into the Aegean Sea and drowned while attempting to escape from the island of Crete early yesterday afternoon. His body has yet to be recovered.

Explanation: Icarus and his father had made wings from wax and bird feathers they had collected over the years while imprisoned on the island of Crete. They attached the homemade wings to their arms and, using a flapping motion, lifted off from the island shortly before noon. While making their escape, Icarus flew too close to the sun. As a result, the heat had melted the wax on his wings which caused the feathers to drop off. The wings collapsed and Icarus fell into the sea and drowned.

Additional Information: Daedalus, sobbing from the distant shore where he had landed safely, said, "My last words to Icarus before we left the island was to stay close and not fly too high! He just didn't listen! Why didn't he listen to me?" Daedalus and Icarus had been held prisoner by King Minos on the island of Crete, and had been forced to build a labyrinth at the palace of Knossos. It was known to be the most difficult maze in the world to navigate successfully .

Writing Experience: Write Your Own Newspaper Article

Directions: Write a newspaper article about the Wright Brothers' aeronautical feat of the first successful, powered airplane flight. Use the guidesheet below to help you plan the information you will include for your article.

Headline:

Byline: By:

Lead Paragraph: Who:

What:

When:

Where:

Why:

How:

Explanation:

Additional Information:

BEYOND ACTIVITIES

Beyond Activities

1. Activity Sheet: Moment in Time

   Create a "Moment in Time" video script describing the first powered flight.

2. Activity Sheet: Evolution of an Idea

   Create a series of models (or drawings) depicting the progression of aircraft that the Wright Brothers created on their way toward powered flight. Use the list below. Include a brief explanation of what problem they were attempting to solve or what theory they were trying to prove with each one.

   A. kite flown, July 1899 (page 23)

   B. glider first flown as a kite, October 1900 (page 23)

   C. manned glider, July 1901 (page 35)

   D. manned glider, October 1902 (page 42)

   E. manned flyer with engine, December 1903 (page 56)

3. Activity Sheet: Conversation with the Brothers

   Create a series of interviews with the Wright Brothers at each of their aeronautical junctures as listed below:

   A. successful wing warping kite, July 27, 1899

   B. glider flown as kite, October 1900

   C. manned glider with attempts at turning, August 1901

   D. after breaking the distance records for gliding with full control of the aircraft, October 1902

   E. December 1903, after achieving powered flight

Beyond Activities (continued)

4. Activity Sheet: Solving the Problems of Flight

Explain how the Wright Brothers solved each of the 3 problems that they had identified at the beginning of their quest for flight:

A. Wings needed to lift an airplane into the air.

B. An engine needed to move it (provide thrust) once it is in the air.

C. Needed a way to control the aircraft's movement.

5. Activity Sheet: Write a Ballad

Following the form for ballad writing, the students break down each year into a stanza that summarizes the setbacks faced and the achievements made by the Wright Brothers. Have them add a chorus that extols their finest accomplishment: sustained, controlled, engine-powered flight.

Student Activity Sheet: A Moment in Time

Directions: Pretend you are a television news reporter who is creating a video series about historical moments in aeronautical history. Create a Wright Brothers segment and entitle it, "A Moment in Time with the Wright Brothers." Place yourself at Kitty Hawk on the day of the historic flight. Include the following information in your video news segment:

- brief biographical information about the brothers;
- brief chronology of the Wright Brothers' work that brings the viewer up to date on how they got to this "moment in time";
- reason why they chose Kitty Hawk for their flight experiments;
- their preparations before the momentous flight;
- your description of the flight;
- a brief interview with each brother about the event.

Try to make the video as realistic as possible and be creative about how you wish to focus on the actual event of the flight. Try to maintain historical accuracy. Use other resources to assist you in making your presentation accurate.

Student Activity Sheet: Evolution of an Idea

Directions: Create a series of models (or drawings) depicting the progression of aircraft that the Wright Brothers created on their way toward powered flight. Use the list below.

A. kite flown, July 1899 (page 23)

B. glider first flown as a kite, October 1900 (page 23)

C. manned glider, July 1901 (page 35)

D. manned glider, October 1902 (page 42)

E. manned flyer with engine, December 1903 (page 56)

With each model or drawing include the following information:

- A brief explanation of what problem they were attempting to solve or what theory they were trying to prove with each one
- The date each one was created and where it was flown
- The dimensions of each actual flying machine

Student Activity Sheet: Interview with the Brothers

Directions: Create a series of interviews with the Wright Brothers at each of their aeronautical junctures as listed below. The interviews can be performed live like a television talk show or as if they are being interviewed on the radio. You can videotape your script or make an audiotape of your interview.

A. successful wing warping kite, July 27, 1899

B. glider flown as kite, October 1900

C. manned glider with attempts at turning, August 1901

D. after breaking the distance records for gliding with full control of the aircraft, October 1902

E. after achieving powered flight, December 1903

Include the following information in each of your interview segments:

- A brief description of the event by either the interviewer or the brothers;
- An explanation of what problems they had to overcome to achieve this step;
- How this brings them closer to achieving controlled, powered flight;
- What problem they have to overcome next to get closer to their goal;
- If performing your interviews live (or on videotape), have some drawings to help illustrate the information.

Student Activity Sheet: Solving the Problems of Flight

Directions: Explain how the Wright Brothers solved each of the three problems that they had identified at the beginning of their quest for flight:

A. Wings needed to lift an airplane into the air.

B. An engine needed to move it (provide thrust) once it is in the air.

C. Needed a way to control the aircraft's movement.

Include the following information in your explanation of each problem:

- State the problem (as done so above)
- Give a one-paragraph explanation of their solution
- Give a step-by-step process of how the problem was solved
- Include illustrations that clearly show their solution as it appeared on their aircraft

Present your information in any of the following forms:

- Written report
- Wall chart or poster
- Hypermedia or Multimedia presentation
- Special feature in an aeronautical magazine

Student Activity Sheet: Writing A Ballad

Songs have been used for many years and are actually poetry put to music. This combination can produce a very pleasant or meaningful experience. Most songs are made up of **stanzas**. A **stanza** is a group of lines with a pattern that is repeated throughout the song. Each stanza has the same rhyme pattern.

Songs often use a very simple rhyme pattern called couplets. A ballad is a song that uses a pattern called a **ballad stanza**. The stanza has four lines in which the second and fourth lines share the rhyme, but the first and the third lines do not share a rhyme with any line in that stanza. Each line also uses a specific amount of syllables. The first line and the third line use eight syllables, and the second and fourth lines use six syllables. Read the example below.

Line 1 - 8 syllables

The engine makes the thrust to go.

Line 2 - 6 syllables/last word rhymes with line 4

Wings make lift, pulling high!

Line 3 - 8 syllables

My fuselage is sleek and strong.

Line 4 - 6 syllables/last word rhymes with line 2

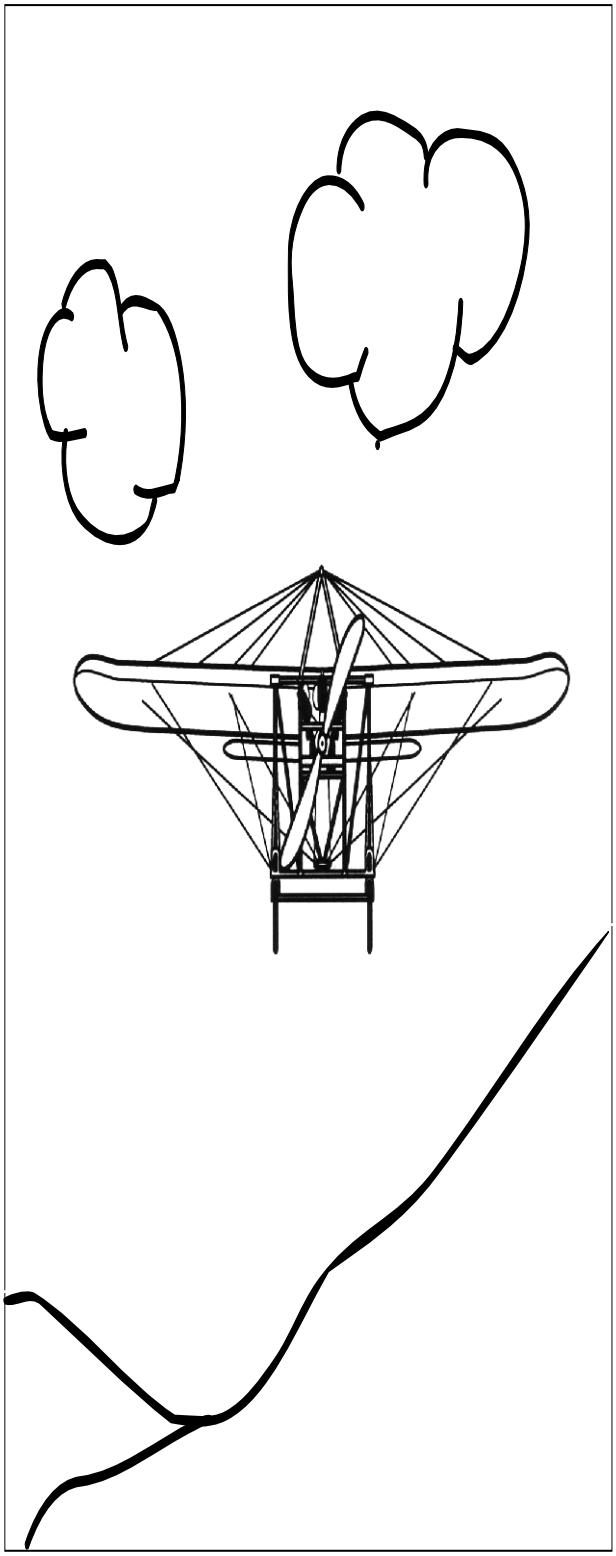
Rise above weight - I fly!

Read the ballad on the next page which uses ballad stanzas.

Bleriot's Dream

By Susanne Ashby

For years he toiled on the ground
over a crazy scheme.
He yearned to make a machine fly;
that was his absurd dream.
He drew, he built, he flew, he crashed;
'times he went round and round.
No matter the bruises, breaks, sprains;
his hope was still profound.
Then came that morning in July
when his craft was ready.
To prove how good it really was
must fly true and steady.
Twenty miles wide, the Channel was
a daring flight to make.
From France to England by airplane
there was a lot at stake.
The motor coughed, the prop did roar,
down the field it did speed.
Quickly climbing into the sky
Pegasus, winged steed!
The French coast disappeared beneath
as swirling mist embraced.
The waves reached up as he flew by
and clouds tried to give chase.
Alone in the sky he flew on
to make his vision true.
White Cliffs of Dover flashed below;
O'er England's coast he flew!
Landing was rough — a broken prop --
loud shouts came from the crowd!
Thirty-seven hours in flight --
the people were quite wowed!
Louis went down in history
as the first one to fly
Across the Channel in a plane;
his dream flight ne'er to die!



Student Activity Sheet: Writing a Ballad

Directions: Follow the form for ballad writing below to help you create a ballad about the Wright Brothers' quest for flight. Break down their quest into individual years, setting each year into a stanza that summarizes the setbacks and achievements faced by the Wright Brothers. Have the final verse extol their finest accomplishment: controlled, engine-powered flight.

Step 1: Manned glider with attempts at turning, August 1901

This stanza will introduce the Wright brothers and tell about their earlier attempts at manned gliders and how they were successful at making turns in their manned gliders.

Step 2: Breaking the distance records for gliding with full control of the aircraft, October 1902

This stanza will talk about how they solved the problem of gliding with full control.

Step 3: Achieving engine-powered flight, December 1903

This stanza will review the fateful day when they succeeded in controlled, engine-powered flight.

Chorus General information

Then add a chorus that gives general information about the who, what, when and where of this momentous occasion.

References to Aeronautical Concepts Presented in Countdown to Flight!

Page(s)	Aeronautical Concept(s) Presented
18	Lilienthal's research • used wing with slight bulge on the top front of the wing, curving gently toward the back • controlled glider by shifting body weight to move the center of gravity and keep in balance
15 - 20	Brief history of flight that discusses the knowledge that had been acquired up until 1897. This was some of the information that the Wright Brothers received.
22	The brothers' solution to balance the wing lift was to construct a smaller, flat, horizontal control surface that could be raised or lowered in front of the wings. It was called a "horizontal rudder" and worked like an elevator. Its purpose was to control the pressure of air as it moved along the wings. This would help maintain the front-to-back equilibrium. To maintain the side-to-side equilibrium, the brothers decided on "wing warping" in which the wingtips would be twisted, one up and the other down, to counterbalance any change in the air pressure.
29 - 30	Changed the way the wings were mounted on the fuselage--not straight out so that they formed a "V" shape. Problem with the rapidly changing center of air pressure under the wings. Using a flat wing, the center of pressure moves forward as its angle to the wind is decreased. When the wing is horizontal and parallel to the airflow, the center of air pressure is on the leading edge. When the wing is curved, the center of air pressure moves forward as the wing angle decreases until it reaches a critical point, then it starts to move backwards. When the center of air pressure moves behind the aircraft's center of gravity, the aircraft nose-dives.

References to Aeronautical Concepts Presented in Countdown to Flight!

(continued)

Page(s)	Aeronautical Concept(s) Presented
29 - 30	They improved wind resistance by placing the pilot in a prone position.
36	The discovery of the stalling angle. As the speed of the glider slowed, the pilot increased the wing angle to compensate and maintain lift. However, at a critical point when the wing angle was very steep, the airflow was insufficient for lift.
38 - 39	Conducted wind tunnel tests to determine optimum curvature of the wing as it relates to lift.
45	One movable, vertical rudder at the rear of the aircraft would give improved control during turns.
50	Propeller Work Propeller blades are airfoils. A turning propeller blade creates an increase in the air pressure behind it. This pushes the propeller toward the lower air pressure area. As the speed of the propeller's forward movement accelerates, the difference between air pressure in front and behind decreases. This decreases the thrust. They needed to be able to maintain the thrust to keep the aircraft airborne.

Exploring Aeronautics: Countdown to Flight Educator Guide
A Supplemental Educator Guide with Activities in Aeronautics and Language Arts featureing the book "Countdown to Flight"

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3. This is a valuable educator guide?
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