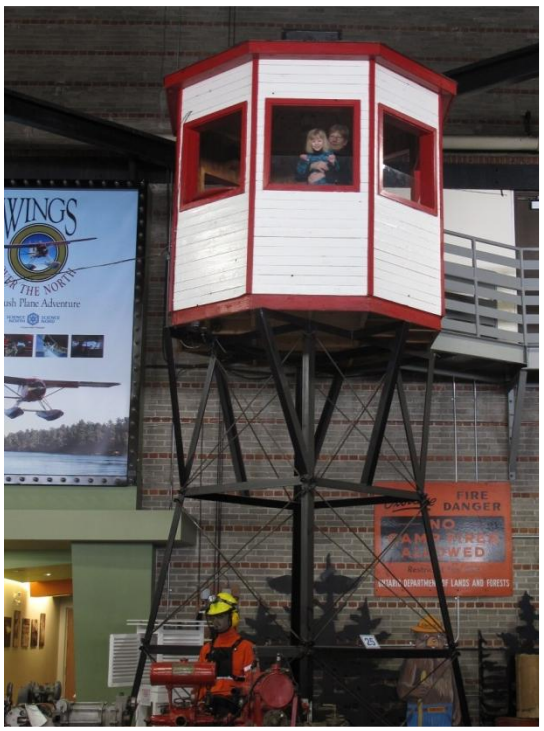
CANADIAN BUSHPLANE HERITAGE CENTRE

CBHC Grade Six Aviation Program



INTRODUCTION

At the Canadian Bushplane Heritage Centre we are passionate about our Northern Ontario heritage. We are also very excited about educating the public on our many historical aircraft exhibits as well as forests and forest firefighting exhibits. Our Education Program will allow you to engage your students and give them a personalized, relevant and exciting new take on the curriculum.

Our program is developed with teachers in mind and will allow you to build on curriculum expectations before and after the tour that all tie into the materials presented in the tour. We would love to partner with you to allow your students to discover and learn about their Northern Ontario heritage and the exciting life as a bushplane pilot or forest fire fighter. Our tour guides are retired educators, MNR workers and/or pilots who love working with kids and students. Our experts make the experience one you and your students will never forget!

Our Grade Six Program focuses on the understanding the structures and mechanisms of flight. Students will have a chance to climb inside, play, touch and even "fly" with their classmates in an old Saunders passenger aircraft. Students will also discover how bushplanes help fight forest fires and will get a chance to climb a fire tower to put out a forest fire on their own. We will ignite your student's imaginations and interest. Your class will learn quickly that adventure takes off at the Canadian Bushplane Heritage Centre!

You may also speak to someone for more information or to book your school tour at
Toll Free: 1-877-287-4752
Local: 705-945-6242

Teacher's Choice of movie: Object Theatre – Wings Over the North, Bush Angels or Wildfires!

OVERVIEW OF CURRICULUM EXPECTATIONS

The following is a list of expectations from the grade six curriculum that will be met by following the Canadian Bushplane Heritage Centre Grade Six Program.

Big Idea:
Flight occurs when the characteristics of structures take advantage of certain properties of air.

Overall Expectation:
Assess the societal and environmental impacts of flying devices that make use of properties of air.

Specific Expectation:
Assess the benefits and costs of aviation technology for society and the environment, taking different social and economic perspectives into account.

How:

Our experts will guide the students through a memorable experience of the Canadian Bushplane Heritage Centre. The students will discover the forces that allow an aircraft to fly as well as how the bushplane has evolved and adapted to meet the needs of the environment, the pilots and the passengers. We will also discuss the advantages and disadvantages of bushplanes.

Big Idea:
Flight occurs when the characteristics of structures take advantage of certain properties of air.

Overall Expectation:
Investigate ways in which flying devices make use of properties of air.

Specific Expectation:
Follow established safety procedures for using tools and materials and operating flying devices.

How:

The tour guide will explain and enforce the rules of the CBHC to all students before they enter the centre.

Big Idea:
Flight occurs when the characteristics of structures take advantage of certain properties of air.

Overall Expectation:
Investigate ways in which flying devices make use of properties of air.

Specific Expectation:
Use scientific inquiry/experimentation skills to investigate the properties of air.

How:

Students will have fun while learning in our Children's Flight Centre this includes flight simulators, arcade-style gaming consoles, displays on the properties of air and flight and students can also sit in a real aircraft cockpit.

Big Idea:
Flight occurs when the characteristics of structures take advantage of certain properties of air.

Overall Expectation:
Investigate ways in which flying devices make use of properties of air.

Specific Expectation:
Use technological problem-solving skills to design, build and test a flying device.

How:

In the post tour lesson that is provided students will test different paper plane designs to see which folding techniques work the best. They will create their design keeping in mind the principles of flight that they have learned during their time at the Canadian Bushplane Heritage Centre.

Big Idea:
Flight occurs when the characteristics of structures take advantage of certain properties of air.

Overall Expectation:
Investigate ways in which flying devices make use of properties of air;

Specific Expectation:
Use appropriate science and technology vocabulary, including aerodynamics, flight, glide, propel, drag, thrust and lift, in oral and written communication.

How:

We create an environment where students experience new terminology and where they see things they have never seen before. Our expert guides allow and encourage questioning while students discover all of this new and exciting information.

Big Idea:
Air has many properties that can be used for flight and for other purposes.

Overall Expectation:
Explain ways in which properties of air can be applied to the principles of flight and flying devices.

Specific Expectation:
Identify the properties of air that make flight possible.

How:

A mini lesson on flight will be given before the students observe the exhibits. The mini lesson will touch on thrust vs. drag and lift vs. gravity, the nature of air, wings, stabilizers, fin, aileron, elevator, rudder, wingspan, range and ceiling.

Students will have fun while learning in our Children's Flight Centre, this area includes flight simulators, arcade-style gaming consoles, displays on the properties of air and flight and students can also sit in a real aircraft cockpit.

Big Idea:
Air has many properties that can be used for flight and for other purposes.

Overall Expectation:
Explain ways in which properties of air can be applied to the principles of flight and flying devices.

Specific Expectation:
Identify and describe the four forces of flight – lift, weight, drag and thrust.

How:

A mini lesson on flight will be given before the students observe the bushplanes it will touch on thrust vs. drag and lift vs. gravity, the nature of air, wings, stabilizers, fin, aileron, elevator, rudder, wingspan, range, ceiling as well as the Newtonian Effect and the Bernoulli Principle.

Big Idea:
Air has many properties that can be used for flight and for other purposes.

Overall Expectation:
Explain ways in which properties of air can be applied to the principles of flight and flying devices.

Specific Expectation:
Describe, in qualitative terms, the relationships between the forces of lift, weight, thrust and drag that are required for flight.

How:

A mini lesson on flight will be given before the students observe the bushplanes it will touch on thrust vs. drag and lift vs. gravity, the nature of air, wings, stabilizers, fin, aileron, elevator, rudder, wingspan, range, ceiling as well as the Newtonian Effect and the Bernoulli Principle.

Big Idea:
Air has many properties that can be used for flight and for other purposes.

Overall Expectation:
Explain ways in which properties of air can be applied to the principles of flight and flying devices.

Specific Expectation:
Describe ways in which flying devices or living things use unbalanced forces to control their flight.

How:

A mini lesson on flight will be given before the students observe the bushplanes it will touch on thrust vs. drag and lift vs. gravity, the nature of air, wings, stabilizers, fin, aileron, elevator, rudder, wingspan, range, ceiling as well as the Newtonian Effect and the Bernoulli Principle.

Big Idea:
Air has many properties that can be used for flight and for other purposes.

Overall Expectation:
Explain ways in which properties of air can be applied to the principles of flight and flying devices.

Specific Expectation:
Describe ways in which the four forces of flight can be altered.

How:

A mini lesson on flight will be given before the students observe the bushplanes it will touch on thrust vs. drag and lift vs. gravity, the nature of air, wings, stabilizers, fin, aileron, elevator, rudder, wingspan, range, ceiling as well as the Newtonian Effect and the Bernoulli Principle.

Terminology and Additional information:

- **The Nature of Air:**

1. Air is a gas and behaves like a gas; gases have three characteristic properties: (1) they are easy to compress, (2) they expand to fill their containers and (3) they occupy far more space than the liquids or solids from which they form. Gases can fill a container of any size or shape. That is one of their physical characteristics. Think about a balloon. No matter what shape you make the balloon it will be evenly filled with the gas atoms. The atoms and molecules are spread equally throughout the entire balloon. Liquids can only fill the bottom of the container while gases can fill it entirely.
2. Air is matter therefore it takes up spaces and has mass. Gas is everywhere. There is something called the atmosphere. That's a big layer of gas that surrounds the Earth. Gases are random groups of atoms. In solids, atoms and molecules are compact and close together. Liquids have atoms a little more spread out. However, gases are really spread out and the atoms and molecules are full of energy. They are bouncing around constantly.
3. Air can exert force and move around. Gases hold huge amounts of energy and their molecules are spread out as much as possible. With very little pressure, when compared to liquids and solids, those molecules can be compressed. It happens all of the time. Combinations of pressure and decreasing temperature force gases into tubes that we use every day. You might see compressed air in a spray bottle or feel the carbon dioxide rush out of a can of soda. Those are both examples of gas forced into a space smaller than it would want and the gas escapes the first chance it gets.

- **Aerodynamics:**
  Have students stand in the flight centre with enough room around them to swing their arms. What makes an aircraft fly? Air — the stuff that's all around you. Hold your hand in front of your body with your palm facing sideways so that your thumb is on top and your pinkie is facing the floor. Swing your hand back and forth. Do you feel the air? Now turn your palm so it is parallel to the ground (palm facing the ground) and swing it back and forth again, like you're slicing it through the air. You can still feel the air, but your hand is able to move through it more smoothly than when your hand was turned up at a right angle. How easily an aircraft moves through the air or its aerodynamics, is the first consideration in making an aircraft fly for a long distance.
- **Drag and Gravity:**
  Aircraft that push a lot of air, like your hand did when it was facing the side, are said to have a lot of "drag," or resistance, to moving through the air. If you want an aircraft to fly as far as possible, you want an aircraft with as little drag as possible. A second force that aircraft need to overcome is "gravity." You need to keep an aircraft's weight to a minimum to help fight against gravity's pull to the ground.
- **Thrust and Lift:**
  "Thrust" and "lift" are two other forces that help an aircraft make a long flight. Thrust is the forward movement of the aircraft. The initial thrust comes from the "engine" as the aircraft is taking off. Lift comes when the air below the aircraft's wing is pushing up harder than the air above it is pushing down. It is this difference in pressure that enables the aircraft to fly. Pressure can be reduced on a wing's surface by making the air move over it more quickly. The wings of an aircraft are curved so that the air moves more quickly over the top of the wing, resulting in an upward push or lift, on the wing.
- **Range & Ceiling:**
  Ceiling is the highest altitude from which the ground is still visible in a particular weather condition.
  Range is the maximum distance an aircraft can fly without being refuelled.
- **Bernoulli Principle:**
  Bernoulli's Principle is the principle that allows wings to produce lift and aircraft to fly. There are many factors that can affect the lift produced under this principle, but in order to fully understand how and why things can fly one must understand how Bernoulli's principle works. Bernoulli's principle works on the idea that as a wing passes through the air the shape of the wing make the air travel more over the top of the wing than beneath it. This creates a higher pressure beneath the wing than above it. The pressure difference causes the wing to push upwards and lift is created. There are several things that affect the amount of lift created. The first is speed, the faster the wing moves through the air the more air is forced over and under the wing, therefore the more lift is

created. Another thing that affects the amount of lift created is the density of the air. The denser the air is the more lift is produced. This is why aircraft climb better in the winter, the colder air is denser. The final thing that can change the amount of lift created by the wing is the shape of the wing. Certain wing shapes produce more lift.

- **Newtonian Effect:**

  Laws of Motion

  Sir Isaac Newton proposed three laws of motion in 1665. These Laws of Motion help to explain how an aircraft flies.

  1. If an object is not moving, it will not start moving by itself. If an object is moving, it will not stop or change direction unless something pushes it.
  2. Objects will move farther and faster when they are pushed harder.
  3. When an object is pushed in one direction, there is always a resistance of the same size in the opposite direction.

  Law 1: Inertia The law of inertia has two parts. The first part states that an object at rest will stay at rest unless acted on by a force. A force is a push or a pull. Inertia can be seen when someone pulls a tablecloth out from under dinner plates and the plates stay on the table; the plates stay at rest. Likewise, an aircraft sitting on the runway will stay at rest until the engine forces it to move.

  The second part of Newton's first law states that an object in motion will stay in motion in a straight line, unless acted on by a force. You experience inertia every time a car stops and your body continues to move forward, pulling against the seatbelt and shoulder strap. Were it not for very powerful brakes, a fast-moving aircraft would continue to roll right off of the runway.

  Inertia is a property of mass; massive aircraft have more inertia than smaller aircraft. Therefore, massive aircraft require much more force to speed up or slow down.

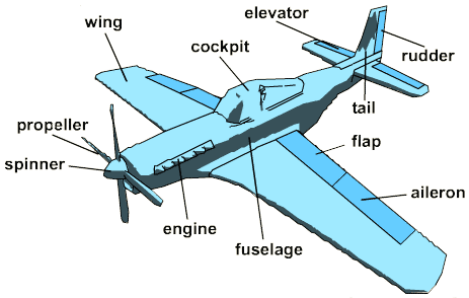
  Law 2: Force and Mass

  Newton's 2nd law states that the acceleration of an object is inversely proportional to its mass. In other words, it is difficult to change the speed of massive objects and it is easier to change the speed of smaller objects. Example: imagine a motorcycle, a car and a big truck at a stoplight, each with the same horsepower motor. Which vehicle will have a greater acceleration? The motorcycle will have a greater acceleration because its mass is smaller. (Acceleration = Force/Mass) As compared to a massive aircraft, a small aircraft is easier to accelerate. Newton's 2nd law also states that the rate at which an object changes speed is proportional to the force that is exerted. Engines provide thrust and accelerate an aircraft forward along the runway. If the engines supply a small force, only a small acceleration will result. If a larger force is generated, a larger acceleration will result.

  Law 3: Force = Force

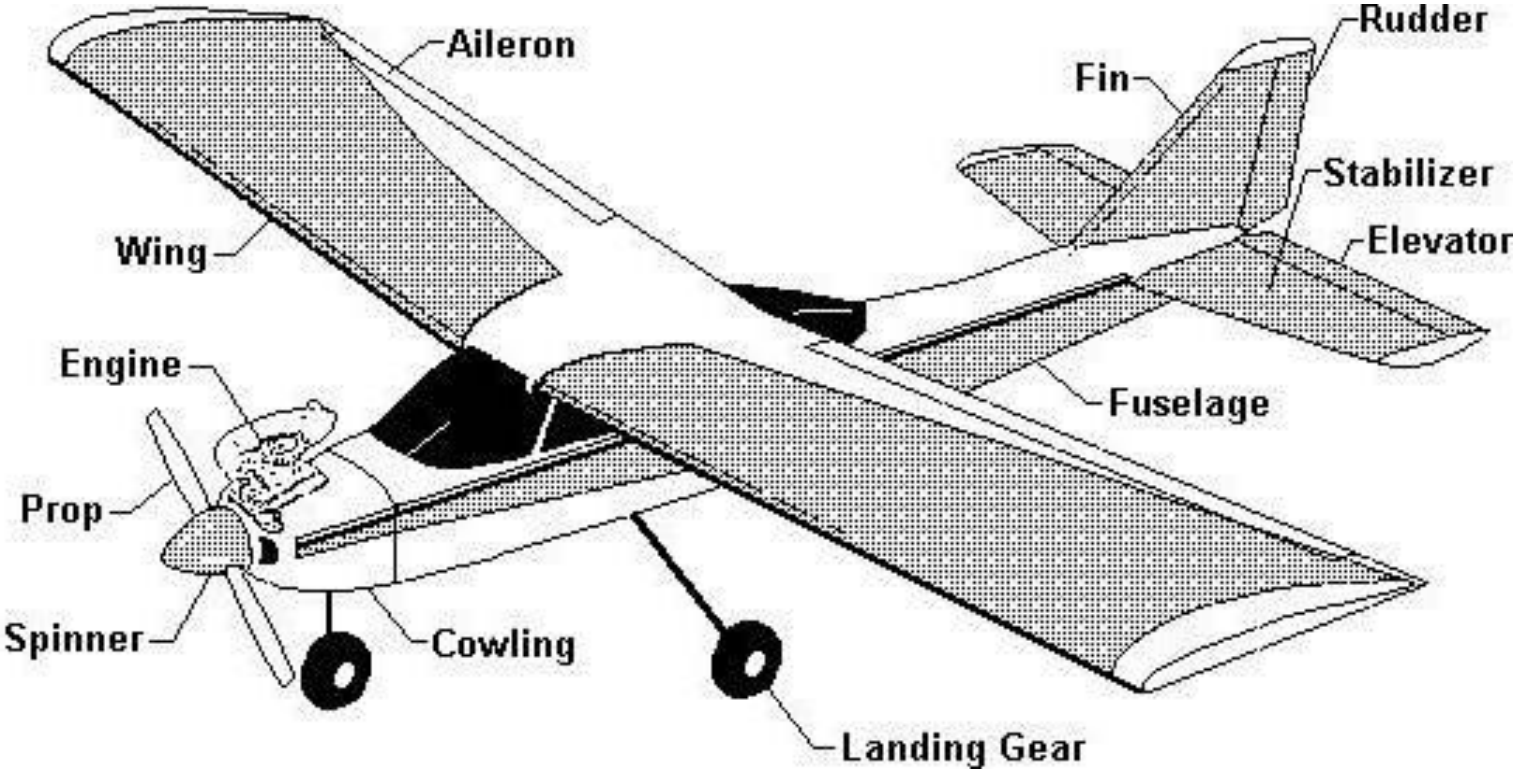
  Newton's 3rd Law states that forces always come in equal and opposite pairs. Squeeze your index finger and thumb together. Which pushes with more force? No matter how hard you squeeze, the forces are equal. Your thumb and finger interaction is an example of an action-reaction pair. Consider some examples of action-reaction pairs associated with an aircraft: As an aircraft sits on the runway, it applies a force on the earth and the earth pushes back with an equal and opposite force. As an aircraft flies, the force of the air hitting the aircraft is always equal and opposite to the force of the aircraft pushing against the air. The force generated by the engine pushes against air while the air pushes back with an equal and opposite force.

Parts of an aircraft (use actual bushplanes to show the parts during the tour):



Aileron - Surfaces on the wing that moves up and down.
Cockpit – Control centre where pilot, instrumentation and navigational aids used in flying are located.
Elevator - Surface on the horizontal part of the tail section that moves up or down to assist the aircraft in maintaining level flight and adjusting the pitch of the aircraft.
Engine - Part of the aircraft that provides the power for takeoff and landing and sustains flight.
Flap - Retractable trailing edge of a wing that moves down to increase wing surface and increase lift on takeoff.
Fuselage - Body of an aircraft, excluding the wings and tail.
Propeller - Twisted airfoil or turning blade, powered by the engine and providing thrust.
Rudder - Vertical part of the tail section that moves left or right to stabilize the aircraft during crosswind takeoff and landing or in severe wind conditions.
Spinner - Part of the shaft that covers the centre of the propeller and helps smooth the airflow over the engine.
Tail - Section of the aircraft housing the elevator, stabilizer, fin and rudder.
Wing - An aircraft's airfoil, producing lift as the craft moves through the air. It has two moveable controls: ailerons and flaps.

Aircraft Diagram



GRADE SIX LESSONS

Associated lessons are encouraged before and after the field trip. Many students may not have been to a museum and it is helpful to establish the rules of a museum as well as get them excited to come and experience all the fun adventures they are about to have. The following activities are all optional; our tours are developed to be stand-alone and pre or post lessons are not required to experience a field trip at the Canadian Bushplane Heritage Centre.

You can use one lesson or a combination of lessons to aid your students in their experience. All the resources for the activities are supplied and most of the suggested books may be lent out through our own library for up to one week. Some books are also noted to be in the Public Library for teachers to take out for longer periods of time.

You may also speak to someone for more information or to book your school tour at
Toll Free: 1-877-287-4752
Local: 705-945-6242

Lesson 1

Students Will Discover:

- What factors affect how well an aircraft will fly.

Materials:

- Internet sites or books for folding instructions for paper planes. (See suggested reading)
- 8 x 11 standard paper
- Tape
- Paperclips

Lesson Plan:

- Tell the students that they will each be making a paper plane (you could also do this in groups if you wish).
- Have student's research different ways for folding paper planes keeping in mind what they have learned about planes and their design and what design strategies make a plane able to fly for a greater distance.
- Once they have chosen a design they will each get 1 piece of standard 8 x 11 paper, 1 piece of 10cm long tape and one paper clip to make their paper plane.
- Give students time to fold their paper into their desired design. (Extension: Let students decorate their paper plane)
- Ask students to not test their paper plane in the classroom as this could be dangerous and chaotic.
- Students will then compete to see who has built the paper plane that will fly the furthest. The best place to do this is in the gymnasium or outside if the weather permits.
- Choose one person or you as the teacher to mark where the paper plane has landed. One at a time students will step up and test their paper plane. All students will start at the same mark and throw their paper plane. The person you have chose as the marker will then mark that spot either with tape or stand in place using their body as a marker. As each student takes their turn you will only need to mark the spot if the paper plane has gone further than the spot marked.
- Once everyone has gone have students look at the paper plane that went the furthest. Either have a class discussion or a writing assignment when the students will answer the following questions:
    - Why do you think this paper plane went the furthest?
    - Using what you have learned about plane design, what aspects has the creator used in their design?
    - What aspects of your own paper plane may have caused it to not go as far?

Lesson 2

Students Will Discover:

1. An increased speed of airflow over a surface results in a decrease in air pressure over that surface.
2. Air moves faster over a cambered or arched, surface than over a flat surface
3. Together, these two facts explain how an aircraft lifts into the air and stays in the air.

Materials:

- Two sheets of paper
- Two empty soda cans
- Transparent drinking straw
- Scissors
- A cup of water

Lesson Plan:

1. Review with your students what they have learned about the principles of flight. Then let them know that they are about to perform a series of simple experiments that will demonstrate the principles that make it possible for an aircraft to lift into the air and remain aloft.

2. Divide the class into groups, providing each group with the materials listed above.

3. Instruct the groups to perform the following brief experiments. Before each experiment, have group members predict the result.

- Hold two sheets of paper so that they are hanging vertically with their surfaces facing each other, close together in front of your mouth. Now blow in between the papers and observe the result. (The sheets of paper will move closer together.)
- Lay two empty soda cans on their sides, parallel to each other and fairly close together on a table or desk. Holding a drinking straw between the cans and parallel to them, blow through the straw. What happens to the cans? (They will move closer together.)
- Cut a transparent drinking straw into thirds and hold one segment upright in a cup of water, with the top of the straw segment above the surface of the water. Blow across the top of the straw and observe what happens to the water in the straw. (The water level will rise.)

4. Discuss with the class as a whole what they can infer from their experiments. Encourage them to offer reasons for their results. If necessary, explain that increased speed of airflow over a surface causes a decrease in air pressure over that surface. Because of the decreased pressure between the sheets of paper and between the soda cans, the objects moved closer to each other; less pressure was pushing them apart. Likewise, because less pressure was holding the water down in the straw, the water level went up.

5. Continue the discussion by asking students to relate what they have learned to an explanation for how an aircraft lifts into the air. When you remind students that an aircraft first gathers speed on the ground before it takes off, they should be able to infer that the increased speed of airflow over the wings causes a decrease in pressure over the wings.

6. Finally, pose the following questions: “Why doesn't the increased speed of airflow under the wings cause an equal decrease in air pressure?” and, “Wouldn't the speed of airflow have to be faster over the wings than under to make the aircraft take off?” To help students answer this question, have them visualize the shape of an aircraft wing. You might also ask them to visualize the shape of a bird's wing. They are both cambered or arched upward.

7. Assign each group to use research materials to answer the questions you have posed and write a brief answer and explanation, accompanied by a labeled diagram. They should discover that air moves more quickly over an arched surface than over a flat surface. The speed of airflow is therefore faster over the wings of an aircraft (or bird) than under, causing a decrease in pressure over the wings, but not under them.

8. Challenge students with one more question: “What would happen if an aircraft stopped moving in midair?” Students should be able to infer that it would crash; a constant airflow over the wing is necessary to keep the aircraft aloft.

Suggested Reading:

Fast & Fun Paper Planes,
Paul Jackson, Sterling Publishing Co., Inc., 2004.

- Easy to make, cleverly designed and fun to fly, these innovative paper planes come from origami masters around the world. More than 30 projects, accompanied by ample colourful drawings that direct every fold, include simple planes for newcomers, as well as advanced and unusual "high tech" patterns for ambitious "pilots".

The Kid's Guide to Paper Planes,
Christopher L. Harbo, Capstone Press, 2009.

- A detailed guide to folding those paper missiles that have been the bane of elementary-school teachers since the invention of paper. Kids, on the other hand, will love this: using colourful, vivid and clear step-by-step illustrations, to create simple to complex paper planes.

Super Paper Planes: Biplanes to Space Planes,
Norman Schmidt, Sterling Publishing Co., Inc., 1995.

- With nothing more than paper, ruler, pencil, scissors, glue stick and this all-color extravaganza of super fliers, you can create 28 different planes that really zip through the air--and that demonstrate the history of modern flight. Each flier is complete with historical, technical and scientific information, as well as detailed diagrams and instructions and a full-color photo.

The Magic School Bus Taking Flight: A Book about Flight,
Joanna Cole, Scholastic Inc., 1997.

- In order to discover how things fly, Ms. Frizzle and her class are shrunk inside Wanda and Tim's model plane and learn about how wings and moving air affect flight in a series of high flying adventure.

The Magic School Bus "Taking Flight" DVD,
Kermit Frazier and George Arthur Bloom, Warner Home Video, November 4, 1995.

- Wanda and Tim have built a model plane together for a model show. Ms. Frizzle decides to shrink the class, so they can fly in it. Tim, Phoebe and Liz stay on the ground to operate the remote control, at least until it gets smashed. The class learns all about flight. Meanwhile, Tim, Phoebe and Liz try to turn the bus into different planes (two of which can't fly) to go rescue them.

The Science of Air: Projects and Experiments with Air and Flight,
Steve Parker, Heinemann Library, 2005.

- Experiments and projects using everyday materials. An introduction to the topic followed by two-page spreads of each scientific concept. The 12 experiments have a materials list and step-by-step photo instructions. Boxed text explains the scientific ideas in each project and the processes that make it work and offer ideas for further experimentation. The activities are followed by a history of the topic and a useful glossary. Topics include air movement, air pressure, wind resistance, lift, flight and energy from the wind.