SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

Flight Part 4 **Grade 6 – Flight**

Lesson Plan

Assessment	AFL, model, experiment
Cross-curricular	History

Big Ideas

- Flight occurs when the characteristics of structures take advantage of certain properties of air.

Learning Goals

- To become familiar with the history of the first real airplanes.
- To discover how airplanes can be controlled with rudders, ailerons, and elevators.
- Understand how an airfoil works

Specific Expectations:

2.1 follow established safety procedures for using tools and materials and operating flying devices
2.4 use technological problem-solving skills to design, build, and test a flying device
2.5 use appropriate science and technology vocabulary, including aerodynamics, compress, flight, glide, propel, drag, thrust, and lift, in oral and written communication
3.3 identify and describe the four forces of flight – lift, weight, drag, and thrust
3.4 describe, in qualitative terms, the relationships between the forces of lift, weight, thrust, and drag that are required for flight
3.5 describe ways in which flying devices or living things use unbalanced forces to control their flight
3.6 describe ways in which the four forces of flight can be altered

Description:

This is the **fourth** lesson out of a five-lesson unit. We are now up to the development of true heavier than air flight in our historical review. Students will modify their gliders (paper airplanes) from the previous day to learn how they can be controlled.

Materials/Resources:

Scissors, Paper, Tape
Straws, Skewer
Hair dryer

Safety Notes

Introduction

Let's continue our journey through the history of flight now to learn about the pioneers who built the first true air planes.

Slide Show

- Slide 1: Airships
  - Inventors fitted motors to balloons early on.
  - Airships were developed before airplanes.
  - There are different types. Some have rigid structures inside – we tend to call them Zeppelin's (even though that was just one company). Ones without any rigid structure are called "blimps".
- Slide 2: Airships were huge!
  - Were used to make cross Atlantic flights until 1937 (it would take several days)
  - Could carry almost 100 crew and passengers
- Slide 3: What it looked like onboard
  - Luxurious living quarters
  - Much of the living quarters were housed inside the structure.
- Slide 4: Hindenburg accident
  - Very famous accident that brought about the end of airships.
  - The hydrogen gas inside the air ships is very flammable!
  - It was later found that a spark ignited the petroleum based paint on the Hindenburg. However the golden era of airships came to an end.
  - Today all blimps are filled with helium – not hydrogen.
- Slide 5: Wright Brothers
  - Let's go back now to airplanes!
  - Ran a printing press and bike shop before becoming interested in flight.
  - Meticulously tested their designs, with gliders, kites, and a wind tunnel.
  - First powered and sustained flight in history in 1903.
- Slide 6: Continued development
  - Wrights kept innovating on their designs
  - At first many thought they were bluffing about their achievements because they were so secretive.
  - Eventually showed the world just how far ahead they were, especially with their 3-axis controls (they used wing warping instead of ailerons).
- Slide 7: The Silver Dart
  - First airplane to fly in Canada in 1909
  - Developed by Wrights rival Glenn Curtiss and his group including Alexander Graham Bell.
  - The flight occurred near Alexander Graham Bells' home in Bedeck Nova Scotia.
- Slide 8: Airplanes rapidly advanced after that. This is an image of Billy Bishop with his airplane towards the end of the First World War – so less than 10 years later.

Action

Build an airfoil (demo or activity)

- We discussed yesterday that to change the LIFT of an airplane we need to modify the wing design. The Wright brothers and the inventors before them who developed gliders knew about something called air foils. Air foils do just that - they provide lift.
- Let's briefly return to an activity we did in lesson 2: The demonstration of Bernoulli's principle we did by walking across the class room.
    - What shape did we walk?
    - Which side has the molecules further apart?
    - Do you think this kind of shape for an airplane could help push it up?
    - Let's see!
- **Build and demonstrate an airfoil** (you can just demonstrate this or have them do it, see image file for reference)
    - Cut a strip of paper about 5 cm wide and the length of a letter size sheet of paper.
    - Fold the strip so one side is about 2 cm shorter than the other side.
    - Tape the two ends of the strip together so you get an arch.
    - Poke a hole into the middle of the arching half of the paper with a pencil
    - Push the arch forward so you get an airfoil shape and mark the bottom piece of paper through the hole.
    - Poke a hole through the bottom paper in this location.
    - Insert about a 5 cm piece of straw through the holes.
    - Tape the two sides of the airfoil in place on the straw so they can't slide up or down.
    - Optional: attach a piece of string that you can gently pull on to keep the airfoil from spinning (see image)
    - Insert a skewer through the straw.
    - Hold the airfoil in front of a hairdryer. Note how it will rise if the airflow hits it the right way.

Modify paper airplanes (see reference image)

- Let's explore a bit more now about HOW airplanes control their flight direction. For this we will modify our paper airplanes.
- Let's pick one of your airplanes that flew well yesterday and make some modifications to it.
- Throw it again to remind yourself how it flew.
- Ailerons:
    - First cut a flap on each back edge of the wings, fairly close to the tip of the wing.
    - Bend one flap up, and bend the other one down.
    - Throw the airplane (in the designated area).
    - What do you notice? (You should get airplanes that corkscrew a LOT more. This is called the airplane's "roll")
    - Ailerons can be used to control the roll of the airplane.
    - In practice ailerons would constantly adjust to keep the roll of the airplane as wanted. You would not normally have the ailerons in the configuration we use for demonstration here, unless the pilot was doing a trick to "corkscrew" the plane.

- Elevators:
    - Make another cut beside the ailerons so you get two flaps on each wing edge.
    - Straighten out the ailerons but slightly bend UP the new flaps.
    - Throw the airplane again. Compare to what happens if you bend the flaps down.
    - You will notice with these flaps you can control if the airplane goes up or down. These are called the elevators, they control the pitch of the airplane (up or down)
- Rudder
    - Cut a paper triangle and attach at the rear end of the plane (unless your paper airplane already has a tail)
    - Cut a rudder flap into the rear edge of the tail (see image)
    - Throw the airplane and notice what happens when you bend the rudder one way versus the other.
    - The rudder controls left and right turns for an airplane. This is called the yaw.
- Stabilizers
    - On an airplane stabilizers are usually located on the tail. For paper airplanes you can achieve greater stability very easily though by bending up the tips of the wings on both sides. Try this and see if your airplane flies more evenly.
    - Simple airplanes that may not fly very well can dramatically improve their performance if you just add stabilizers.

Consolidation/Extension

- We have now seen a number of features that make it possible to control flying. You could take what you learned and modify another airplane to perform in a particular way. For example:
    - Modify an airplane to achieve longer flight.
    - Make modifications to allow the airplane to navigate around an obstruction.
- Look at examples of early airplanes and notice/describe the evolution in control systems. Some airplanes didn't have tails for example, or had pitch control surfaces in front of the wings etc.