SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

**Flight Part 5** **Grade 6 – Flight**

# Lesson Plan

| | |
|---|---|
| Assessment | AFL, questions, model |
| Cross-curricular | |

## Big Ideas

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

## Learning Goals

- Understand the connection between the forces of flight and airplane controls
- Build a simple helicopter model
- Learn about modern flight

## Specific Expectations:

**2.1** follow established safety procedures for using tools and materials and operating flying devices (e.g., aim flying devices away from each other when launching them; fly kites and airplanes a safe distance from overhead hydro wires)
**2.4** use technological problem-solving skills to design, build, and test a flying device (e.g., a kite, a paper airplane, a hot air balloon)
**2.5** use appropriate science and technology vocabulary, including aerodynamics, compress, flight, glide, propel, drag, thrust, and lift, in oral and written communication
**3.6** describe ways in which the four forces of flight can be altered

## Description:

This is the **fifth** lesson out of a five-lesson unit. Students will build a simple model helicopter and learn about the connection between the forces of flight and airplane controls

## Materials/Resources:

Cardboard
Straws
Tape

## Safety Notes

## Introduction

**Discussion: Controlling Airplanes and Forces of Flight**

Take time to discuss this. It is a great way to re-enforce the forces of flight and also to really understand how they work. Don't hesitate to throw a paper airplane again and think through what happens when you change its direction.

- Yesterday we discussed how an airplane can be controlled using the rudder, elevators, and ailerons. Let's remind ourselves again as well what the forces of flight were:
    - Weight
    - Lift
    - Thrust
    - Drag
- So what do you do to the forces of flight when you change direction of an airplane? What happens if all the forces are balanced? (meaning weight = lift and thrust = drag)
    - When all forces are balanced then the airplane will fly at a constant speed and in a constant direction.
    - So we have to unbalance the forces to change direction.
- What force balance has to change to go up or down?
    - Weight and lift. Since weight is a constant it means we have to change the lift of the airplane. More lift to go up, less lift to go down. That is what elevators do!
    - How does this differ from a hot air balloon? (The weight of a hot air balloon is not a constant. We can release sand from bags to help rise. To go down the air temperature is reduced – which increases the weight of the balloon system).
- What force balance has to change to turn left or right?
    - … It's still lift. But now we need a different lift on the left versus right wing.
    - E.g. less lift on left and more on the right makes the airplane bank left.
- What forces change the speed?
    - We have to change the thrust to go faster!
    - Drag is a response to the airplane's speed. So it will increase if we go faster and that is why it will take more fuel to fly faster.
    - To slow down an airplane uses flaps – which increases drag.

**Modern Flight**

Let us now conclude our historical tour of flying by looking at modern airplanes. To truly appreciate flying it's really best to see it in person – and the next best thing to that, is watch some videos. Here are some really neat examples of modern airplanes in flight:

- A great montage of close fly-bys of all kinds of interesting planes: https://www.youtube.com/watch?v=9Twv1-flnUw
- Tilt rotor aircraft: https://www.youtube.com/watch?v=mbnWhgk64so
- World's largest airplane – the Antonov 124: https://www.youtube.com/watch?v=l1JP67JxtXI
- Stunt airplanes: https://www.youtube.com/watch?v=uaM9aryUGUs
- The Canadian Snowbirds: https://www.youtube.com/watch?v=LnxNRbkcANI
- Aircraft carrier take-offs and landings: https://www.youtube.com/watch?v=IpOBwbwg7-s
- Helicopters showing their tricks: https://www.youtube.com/watch?v=9pBHB7tYceg

## Action

**Discussion**

- Helicopters are really neat flying machines. They have many capabilities:
  - Highly maneuverable
  - Can land and take-off in one spot
  - Can lift heavy loads
  - Give the occupants almost a 360 degree view
- Drones, which are rapidly becoming extremely popular and have many potential applications, are based on the helicopter design.
- How do helicopters fly?
  - They have two rotors. The large rotor is used for lift; the small vertical rotor on the tail is used for steering and stability.
  - Just like airplane wings, rotors are in the shape of air foils. As they spin they create lift.
- As our last activity we will build a helicopter rotor than can take off.

**Build a Helicopter**

We prefer this activity to the very common paper helicopter as it gives students a model that they can make rise by spinning it. The standard paper helicopter only turns as it falls and so does not really demonstrate how a real helicopter flies.

- Instructions (see reference image):
  - Cut two rotors out of cardboard. The exact shape is not critical. It will be fun to compare different shapes. Keep the size between 3 and 10 cm or so though.
  - Tape the rotors to a straw so they stick straight out opposite to each other. Each rotor should be turned to about 45 degrees (in opposite directions).
  - Make sure the rotors are taped well so they don't fall off when you spin them.
  - Take the straw between flat palms of your hands and give it a good spin and release.
  - After a few tries you should be able to get the "helicopter" to take off up to several feet into the air before falling down.
  - Make several models if you have time playing around with variables: different sizes of rotors, different shapes, add weight to the straw (e.g. a paper clip), or cut off part of the straw to make it lighter.
  - Extra option:
    - If you want you can wind a string or thread around the straw and insert a skewer through the straw
    - Hold on to the skewer and give the string a good pull to really get the rotor spinning fast.
- Discuss results:
  - Which rotors worked really well? Why?
  - What impact did the speed of spinning have on the lift of the rotor? (the faster the higher it goes)
  - What provides the thrust, drag, and lift here?
  - Look at a maple key. How do they compare to your rotor? What is the benefit of that design? (Allows them to fly further from the tree, take off in the wind)

## Consolidation/Extension

**Unit test – attached. Could do today or one of the next days.**

NOTE: You may prefer to create a test in your own style. Our test can be used to give you an idea on what you can focus your questions. Our test is designed in the spirit of inquiry based learning where most questions give the students flexibility in how they answer them and invites them to be creative, and test their knowledge.

**Extension: Demonstrate a drone**

- If you have access to a drone you could demonstrate it for the class. Two great reasons to do this:
    - Drones in many ways may represent the next big evolution in flying.
    - Drones are a form of helicopters, which we talked about today.
- Discuss the benefits and back draws that wide drone usage could have. There are major implications from privacy, to safety, to all the benefits they could provide.

**Extension: The pros and cons of flight**

- Discuss or write about the benefits and back draws of our ability to build airplanes.
- What impact do they have on warfare? Our ability to connect with people around the world? On the environment (think of pollution, but ALSO planes fighting fires for example)? Etc.