

Lesson Plan

Assessment	AFL, models, experiments
Cross-curricular	History

Big Ideas

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

Learning Goals

- Become familiar with the early flying machines
- Be able to identify the forces of 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
- 3.3** identify and describe the four forces of flight – lift, weight, drag, and thrust

Description:

This is the **third** lesson out of a five-lesson unit on flight. In this lesson we learn about the early modern inventors dreaming of flight and will attempt to construct some of our own flying devices (paper airplanes) and finally look at what the forces of flight are.

Materials/Resources:

Lots of sheets of paper
 Scissors
 Rulers (to smooth down edges and potentially mark lines to be folded)
 Tape (just in case to help hold something together or fix a rip)

Safety Notes

You may want to select a “testing zone” for your paper airplanes to avoid contact.

Introduction

Slide Show

In order to gain an appreciation for creative and courageous history of flight we really have to see some of the contraptions that were built before the Wright Brothers came along. This slide show contains a (small) selection that provides a bit of an overview. It is not comprehensive but meant to inspire a bit. One could very easily have the students do a research project on a flying machine of their choice. There are many and the stories of their inventors are colourful and captivating!

- **Slide 1: Flight machines**
 - From the renaissance on, a number of inventors started trying to build a “flying machine”.
 - They were very brave, maybe a bit naïve? Many died in attempts to fly!
 - Let’s look at some of their designs to get an idea of what they came up with.
- **Slide 2: Leonardo Da Vinci**
 - Leonardo Da Vinci is famous for many things. He made many sketches of flying devices, though he never attempted building one.
 - His designs were probably the first ones that were designed with rational thought behind them. The science was bad though.
- **Slide 3: Ornithopter** - His most famous design. Flapping wings would have never worked.
- **Slide 4: Da Vinci’s parachute** actually would have worked! In 2000 a skydiver was able to prove it.
- **Slide 5: Besnier** – another example of an early flying machine. What was he thinking when he launched himself like that?
- **Slide 6: Other designs** – DeGroof died when his machine was released from a balloon and the wings folded up immediately!
- **Slide 7: Balloons** were actually much more successful in getting people airborne.
 - The year 1783 was sort of magical in that both hot air balloons and hydrogen balloons that carried people were invented.
 - The French were very successful pioneers of ballooning.
 - These balloons ascended up to several km into the air!
 - Thousands of people would come watch the launches.
- **Slide 8: Sir George Cayley**
 - Crucial aviation pioneer.
 - Refined much of the science of flight and designed gliders based on science.
 - He made the later developments possible.
 - He defined the forces of flight.
- **Slide 9: Otto Lilienthal**
 - A number of inventors built successful gliders towards the end of the 1800’s.
 - Lilienthal is maybe the most famous.
 - Built his own hill. Did research for decades and studied the results of his flights carefully to build better and better gliders.
 - He died when one of his gliders collapsed.
- **Slide 10:** The evolution from Lilienthal’s first glider to one of his later ones.

Action

Making Paper Airplanes

It may be easiest to do this activity in front of computers so students can look up designs online in the given resources. If that is not an option have copies of the designs on hand for them to choose from. See the other links. You could make different stations where students can share instructions for a few designs (e.g. each station could have a simple, intermediate and hard design). They can then rotate around as they build different ones.

We have now seen a number of flying machine and glider designs. Your turn to build some models! Paper airplanes are actually great examples of gliders. They are not powered (after they are launched). What kind of glider can you come up with?

Instructions

- You should keep your creations, as we will modify them in the next class.
- You should build more than one airplane. Start with a simple one and then challenge yourself to do something harder.
 - Optional: Challenge yourself to make an airplane that stays airborne the longest, flies farthest or the fastest. We will have a competition at the end.
 - HINT: Make sure you fold all creases very well. Especially for complicated designs it's very important that everything is folded exactly and as completely as possible. Use a ruler or your thumb to push the paper together as much as you can!
 - Ask yourself: Why does my plane perform as it does? How could I improve it?
- We have included a selection of neat airplanes that cover a range of difficulty and features. Many more can be found in the online resources!
- Testing airplanes:
 - You may not want paper airplanes flying all over the classroom – so we suggest you select a testing zone or two in your classroom. Students take their airplanes to this area and throw them there, taking turns. Maybe two or three students can throw at the same time.

Consolidation/Extension

The Forces of Flight

- Let us now look at the forces of flight. Pick up one of your airplanes. What forces are acting on it?
 - Gravity is pulling it down – we call this force the weight.
- Is there a force when you throw it?
 - Yes – this is called thrust.
 - If your airplane had an engine, would the thrust continue? (yes – but in our case thrust is only applied before the plane is released)
- Throw the airplane and watch it fly.
 - The airplane slows down. Why? (Air friction)
 - So there is another force – we call it drag.
 - Does the airplane hit the floor as rapidly as if you just let it drop? (Try out – no!). So there must be a force keeping the airplane up against gravity. Though gravity wins, without this force it would hit the floor really fast. This is called lift.

- Discuss: How can we change these forces to make it easier to fly?
 - **Weight:** We can make the airplane lighter
 - **Thrust:** Add a stronger “engine”
 - **Drag:** Make a more aerodynamic design.
 - **Lift:** Design wings that provide more lift. We don’t want to stall though... this is something we’ll explore further tomorrow!