SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

Flight Part 2 **Grade 6 – Flight**

Lesson Plan

Assessment	AFL, demos, experiments
Cross-curricular	

Big Ideas

- Flight occurs when the characteristics of structures take advantage of certain properties of air.
- Air has many properties that can be used for flight and for other purposes.

Learning Goals

- To become familiar with some of the properties of air through inquiry based learning and demonstrations.
- To understand that air has mass.
- Gain an understanding of Bernoulli's principle.

Specific Expectations:

2.2 use scientific inquiry/experimentation skills to investigate the properties of air (e.g., air takes up space, has mass, can be compressed)
3.1 identify the properties of air that make flight possible (e.g., air takes up space, has mass, expands, can exert a force when compressed)

Description:

This is the **second** lesson in a five-lesson unit on flight. In this lesson we focus on better understanding the properties of air.

Materials/Resources:

Mass of air demo: Retort stand, String, Metre stick, balloons
Hot air balloon demo (prepare ahead of time): Dry cleaning bag, Tape, Scissors, Straws or Balsa wood dowels, Aluminum foil, Birthday candles, Lighter, Hair dryer (optional)

Bernoulli's Principle Challenges: Two balloons, String, Piece of paper, Box of straws, Paper cup, Funnel, 3 ping pong balls, A box of plastic bags (e.g. white kitchen waste bags), 2 Dixie cups (or other cups that a ping pong ball JUST fits in)

Safety Notes

Be careful with open flames and electrical devices.

Introduction

Introductory Discussion

- Last day we saw a bit about how animals fly and how humans were able to make objects fly – kites and hot air balloons.
- So what do things fly through? (The air). What is air? (a gas, made up of molecules, etc)
- Do you think air has mass? Does it weigh anything? Let's find out!

Mass of air demonstration

- Blow up two balloons and tape them to the ends of a metre stick
- Hang the metre stick in the middle using a piece of string attached to the retort stand – so it makes a balance.
- Balance the metre stick and balloons so it stays perfectly horizontal (it will sway a bit due to air currents – so just do your best)
- What happens if you let the air out of one of the balloons? – take guesses.
- Carefully cut a hole in the balloon to let the air escape (don't pop it – that will create too much disturbance)
- You should notice the metre stick dipping downward on the side where an inflated balloon is still attached.
- The inflated balloon is heavier than the deflated one on the other side! This is the mass of the air!

Hot air balloon demonstration

Hot air balloons are quite tricky to get them to work and we have to be careful with using fire. Therefore we do not suggest you have students build their own balloons. You will want to prepare and test the balloon ahead of time as it can be a bit tricky to get it to work well!

- Follow the attached instructions to build your hot air balloon.
- On a nice day releasing the balloon outside will work best. The second best option is a room with a high ceiling, such as the gym. If necessary you can also release it in your classroom. Keep a fire extinguisher nearby.
- Have someone hold up the balloon
- Optional: blow hot air into the balloon with a hair dryer until it is fully inflated (keep holding it up). This will speed up the process of getting it airborne.
- Light the candles, making sure not to light anything else!
- Keep holding it lightly until it stands up on its own.
- Watch it rise!
- Discussion:
    - Why did the balloon rise? (Hot air has lower density – making it lighter than cool air)
    - What would you have to do to make the balloon able to lift more weight? (make it bigger, make air hotter)

Simpler demonstration: Fill a dry cleaner bag with hot air from a hair dryer.

- This is safer and much quicker to prepare!
- If the bag has no weight around the opening at all it will tend to turn over, but it should still rise a bit before doing so.
- Simply bunch the bag's opening around the mouth of a hair dryer.
- Fill with bag with air, turn off the hair dryer, point the bag upward (opening down) and release.

Action

Bernoulli's Principle Challenges

The best way to learn about the properties of air is to experience them firsthand. So for the rest of the class students will complete a set of experiments based on Bernoulli's Principle. Students will rotate through stations with instructions and materials to perform an experiment. They should work in groups large enough that all students can be at a station at any time. At each station:

- Discuss what they THINK will happen.
- Write down and/or sketch their hypothesis on their worksheet
- Perform experiment. Take turns to give everyone a chance
- Write down what actually happened.

See attached instructions for setups. You can place these instructions at each station for students.

After performing the experiments come together again. Now discuss Bernoulli's Principle. Alternatively discuss the principle before doing the experiments. But this way you give students an opportunity to try to figure out on their own what happened.

- What did you observe happening? Get students from specific observations to more general statements:
    - Objects move towards faster moving air
    - By blowing air you can decrease its pressure.
    - You can make things RISE by blowing past them (e.g. water in straw or a ping pong ball).
- Bernoulli's principle states that **an increase in the speed of a gas or fluid leads to a decrease in its pressure**.
- Let's demonstrate it by having volunteers do an activity.

Bernoulli's Principle Physical Demonstration (time permitting)

- Students will take two paths from one side of the room to the other. One is direct, the other one curved. You mark the paths by moving the desks or by placing markers down, etc. This exercise would work well in an open area such as a hallway or the gym as well.
- Pick about 10 students and have them divide into two groups. Line them up side by side on one end of the room.
- You are air molecules flowing past an object of this shape (an air foil – though you don't have to mention this yet today. You can ask them though if it reminds them of anything.)
- Each group will follow one of the paths (straight or curved) to the other side of the room. The objective is to arrive at the other end at the same time as the student from the other group that you are paired up with.

- Repeat several times if students need to get the hang of it.
- The class should observe:
    - Which group of students has to move faster? (the one on the curved path)
    - What is the spacing between the students in each group? (the students on the curved path become more separated)
- Discussion:
    - Faster "air" over the curved part of the object.
    - More separation between fast "molecules". This means LOWER pressure!
    - We will come back to this in a couple of lessons!

Consolidation/Extension

As homework or at the end of class:

- Return to your notes on each experiment and explain now based on what you learned about Bernoulli's Principle HOW the experiment works. How can you explain the result using Bernoulli's Principle?
- Have students read about Jacob Bernoulli. The whole family was quite interesting!