



Drexel-SDP GK-12 ACTIVITY

Science

Weather and Aeronautics

Up, Up and Away! Introduction to Forces of Flight

Header



Figure 1

Description: General aircraft cockpit with an occupant flying in the right seat.

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Grade Level _6_ (_5_ - _8_)

Lesson # _3_ of _10_

Lesson Dependency Lessons 1 through 10 of the Weather and Aeronautics Lesson and Activity Group

Time Required: 2 Hours

Summary

Today's lesson prepares students for the construction of the flight model and the wind tunnel by showing students the basic principles of lift. This time, we investigate lift using heavier-than-air

wingless construction, namely rocket propulsion. Properties of rockets will be explored, as well as some more concepts of weather.

Engineering Connection

The aeronautics course is intended as a multi-disciplinary course in physics, math and history of aviation. Navigation, forces of flight, principles of flight, history of flight, and environmental factors (including weather and landforms) are specifically investigated. The core curricular items are emphasized, and aviation is considered an underlying theme. The intent is to provide grounding to the curriculum components learned in a typical K-12 school year. Aviation easily generates a lot of excitement among this age group, and as a result, measurable results are expected in these subjects.

Keywords

- Aeronautics
- Weather
- Aviation
- Flight
- Bernoulli's Principle
- Air
- Cloud Formations

PA Science Educational Standards

- 3.1.7A Explain the parts of a simple system and their relationship to each other.
- 3.1.7B Describe the use of models as an application of scientific or technological concepts.
- 3.2.7A Explain and apply scientific and technological knowledge.
- 3.2.7C Identify and use the elements of scientific inquiry to solve problems.
- 3.4.7C Identify and explain the principles of force and motion.
- 3.5.7C Describe basic elements of meteorology.
- 3.5.7D Explain the behavior and impact of the earth's water systems.

Pre-Requisite Knowledge

None

Learning Objectives

After this lesson, students should be able to:

- Reason about the causes of weather on a particular day
- Know that the relationship between solvent and temperature also applies to temperature, the air, and moisture
- Explain and demonstrate the flight principles of rockets, including their similarities and differences to airplanes

Introduction / Motivation

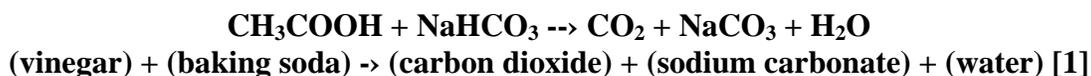
Now that we have seen the principles behind Bernoulli and the basic principles of flight, we investigate other forms of powered lift. This is to show that lift is nothing more than overcoming

weight in a force balance. Vinegar and baking soda are used to create a chemical reaction that propels a “rocket” from a container after giving off CO₂.

Lesson Background & Concepts for Teachers

It is mid-October, and it is a foggy day in the morning. It has been this way for several days, yet the afternoons are always bright with blue skies. I can predict that this will happen again. Why is this possible? Recall that solutions will dissolve more at higher temperatures, precipitation will therefore occur at lower temperatures. The same is true for the air around us. The humidity is the level of saturation of moisture in the air. At warmer temperatures, the air can simply hold more water. At lower temperatures, it can hold less before that water condenses and becomes a cloud, or precipitation. Since it is cooler in the morning and warmer in the afternoons this time of year, this is exactly the weather pattern we tend to experience. We can demonstrate this with a tea kettle, water, and a bag of ice. By moving the warm, moist air surrounding the water-vaper filled boiling kettle to the cool air surrounding the bag of ice, we can form “clouds” and fog more closely to the ground. The sun, in this sense, “burns off” the clouds around midday, because the air can now hold the moisture in the cloud. This concept gives rise to weather phenomena we see every day like thunderstorms. We will learn later how to predict and observe the weather.

We have already seen that wings are one way to produce lift that can overcome the weight of an aircraft. Can you think of another way? Propulsion force is another way we lift objects (like the space shuttle) rapidly from the ground. When that force equals or exceeds the object’s weight, the object will lift from the ground. Let’s try to re-create this idea with vinegar and baking soda. What happens when we mix these things? Technically speaking, it turns into:



We know what water is, and sodium carbonate is not important for our purposes. However, CO₂ is the carbon dioxide gas that we exhale when we breathe [1]. This CO₂ will exert pressure on the sides of our object, until it pops. This can be similarly explored using a balloon [1, 2].

From [3]:

Check with a grown-up before you begin.

You will want to do this outside.

First, tear the paper towels into strips and attach them to the cork with tape. This makes the cork look more like a rocket.

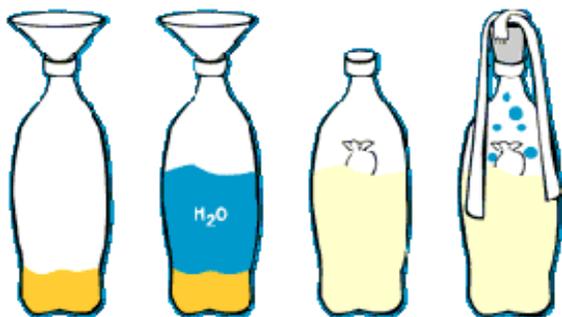
Then, cut a small square out of toilet paper, put about a teaspoon of baking soda in the middle of the square, and fold in the sides to make a little packet.



Put the funnel into the opening of the bottle.

Pour a half inch of lemon juice into the bottle, and then add water until it is a little less than half-way full.

Put on your safety glasses. Drop the baking soda packet into the soda bottle, close the bottle with the cork, shake the bottle, and stand back for lift off.



Here's the reason the cork shoots up. Cherrell says that as the water and lemon juice soak through the toilet paper, the baking soda reacts to produce carbon dioxide. Carbon dioxide is a gas. As more gas forms, pressure builds up inside the bottle and sends the cork flying.

Lemon juice is an acid, and baking soda is a base. When they are mixed together they produce carbon dioxide. Try launching your rocket by mixing other acids with the baking soda. Make a prediction, and then test it out. Be sure to [send us your discoveries](#) so that we can share them with the world!

References

AOPA Path: Pilot's and Teacher's Handbook. <http://www.aopa.org/path/>.

SynergyLearning: <http://cf.synergylearning.org/displayarticle.cfm?selectedarticle=225>.

AIAA Activity Book. <http://www.aiaa.org/kidsplace/kidsplacepdfs/sciact.pdf>.

[1] <http://www.caosclub.org/members/chem2.html>

[2] <http://educ.queensu.ca/~science/main/concept/chem/c06/c06dekk7.html>

[3] <http://pbskids.org/zoom/activities/sci/lemonjuicerockets.html>

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