Let's Go Fly a Kite!

Adapted from http://www.sciencebuddies.org/science-fair-projects/project_ideas/Aero_p016.shtml#background

Abstract

Kites have been a source of entertainment for centuries for kids from cultures around the world. In this science project you will have a chance to investigate how kites fly and then build your very own kite.

Objective

Make a simple kite to use in a series of experiments to test different variables important for flight. Make a competition kite using the information you gleaned from the test kite. The competition kite will be flown to determine the kite building winner.

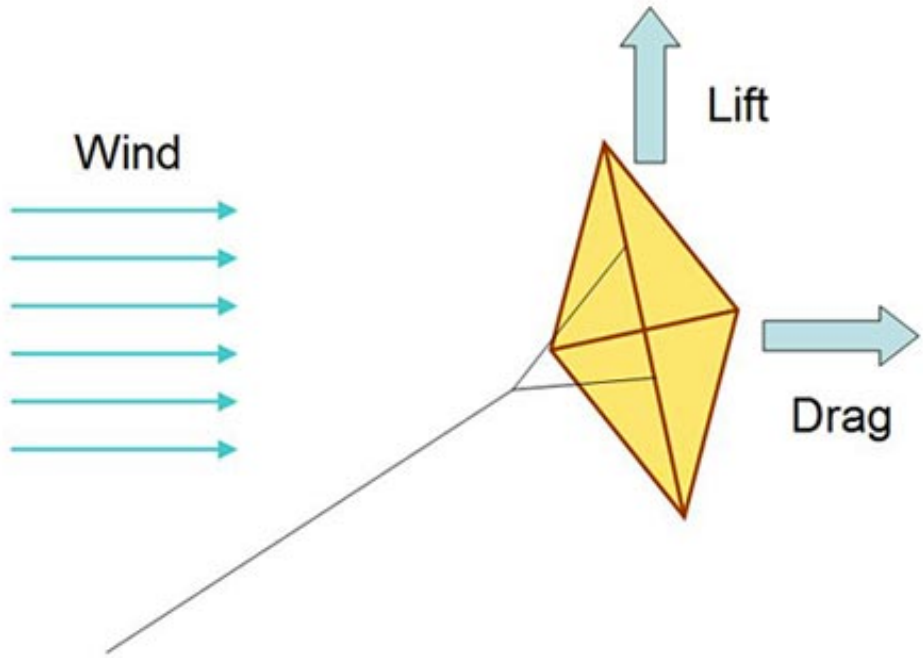
Introduction

Did you know that one of the most famous kite flyers of all time was a 10 year-old boy? His name was Homan Walsh, and with out him the Niagara Falls Bridge would not have been built in 1847. Before building of the bridge could begin, someone needed to get a line from one side of the gorge to the other. Homan successfully flew a kite from one side of the gorge to the other, and his kite line was the first to span the gorge. After securing Homan's initial kite string, heavier and heavier line was fed across until a steel cable could be connected across the gorge so that bridge construction could begin. Homan Walsh was rewarded with a ten-dollar cash prize, which was a lot of money in 1847!

Another famous kite flying duo were the Wright brothers, Orville and Wilbur Wright. Before building the first successful airplanes, they experimented with various designs by using kites. By making many different kite models of their airplanes, they eventually came up with a design that worked, and the rest is history.

There are many different kite designs. Some kite designs are very old, like traditional Chinese and Japanese kites. Some designs are very new, like the dynamic stunt kites used in sport kite flying competitions. These kites are made with modern materials and designs which make them ultra maneuverable. Kites come in all shapes and sizes, as you can see in the picture.

How does a kite fly, allowing Homan and the Wright brothers to accomplish their feats? As someone runs with a kite, the wind going head-on into the kite creates a **force** that pushes up on the kite. This force is called **lift**. This lift force goes perpendicular to the wind and it pushes the kite up into the air. At the same time, another force pulls the kite back. This force is called **drag** and is caused by the wind catching on the kite itself, pushing the kite back in the direction that the wind is going (see Figure 2). Altogether, these forces cause the kite to go back and up when you fly it.



In this aerodynamics science project you will make your own kite for testing how different **variables** affect **flight**. The type of kite you will make is called a **sled kite**, and is very simple to build. After you build the kite you will use it for a series of experiments, testing different variables such as speed, line length, tail length, and any other variable you want to test. Will you be able to figure out the best way to fly a kite?

Terms and Concepts to define:

Definitions ***should be neatly written or typed and turned in by*** _____

- Forces
- Force of lift
- Force of drag
- Variables
- Flight
- Sled kite

Questions you need to answer for this project:

Answered questions should be neatly written or typed and turned in by _____

You should cite the source near the information that you learned. Remember to record the information in your own words so that you do not plagiarize.

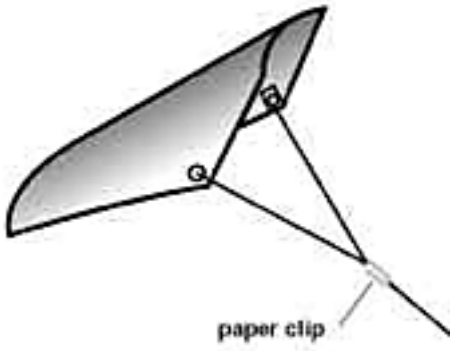
- How do you make a kite?
- What forces allow a kite to fly?
- What variables affect the flight of a kite?
- Why do kites have tails? What do the tails do?

Materials and Equipment

M.1 2 Disposable plastic drinking straws
M.2 6 m string, yarn, line, rope, etc.
M.3 Tape
M.4 Sled Kite Paper Template.
M.5 paper clip
M.6 plastic grocery bags
M.7 hole punch
M.8 A ruler, measuring stick or other measuring device.
M.9 Lab notebook to record notes as you research and experiment with sample kite.

Experimental Procedure

1. You will be provided with 1 copy of the Sled Kite Template for your research. If you need additional copies, download the Sled Kite Template and print it out on a normal sheet of 8 1/2-inch by 11-inch paper.
2. Carefully cut out the sled kite.
3. Trim the length of the two drinking straws so they will fit in the area marked for the straws.
4. Tape the straws into place.
5. Place two or three pieces of tape in the marked areas covering the black circles.
    a. The tape will help reinforce the holes for the kite string.
6. Using the hole punch, carefully punch the two holes marked by the black circles.
7. Cut two pieces of kite string 45 centimeters (cm) long each. Tie a string through each hole. Tie them tight, but not so tight that you tear the paper!
8. Tie the opposite end of both strings together to one end of a paper clip.
9. Cut a 1 meter (m) long piece of string. Tie one end of this string to the other end of the paper clip. Your sled kite should look like the picture and is now ready to fly!



This is an image of a **sled kite** from the Dryden Flight Research Center at NASA (NASA, 2004).

10. Before flying your kite, make some tails to test while flying your kite. You can make kite tails out of old grocery bags or other thin plastic bags by cutting the bag into loops and then connecting these loops. For a visual guide on how to do this, see the webpage by My Best Kite titled "Making Kite Tails" in the Bibliography.
    a. Lay the bag completely flat.
    b. If the bag has handles, cut straight across using scissors to remove the handles

c. Then keep cutting the bag this way to create thin rings (which will look like strips when flat). Make each ring about 3 cm wide.
d. Cut up the whole bag this way.
e. Discard the handles but save the rings.
f. To make kite tails, you can either use individual rings (for a short tail) or loop two rings together and gently pull them tight. Attach more rings to the tail this way to make it longer.

11. You will determine how each variable effects the kite's ability to fly. The variables you will be testing are: tail length, number of tails, kite pilot's speed, and string length. Remember, you will change only one variable at a time to discover the effect each change has to the way the kite flies. In your lab notebook, for each variable make a data table similar to the one below to record your results.

Variable: Tail Length	10 cm	100 cm	500 cm
Result:			
Variable: # of Tails	No Tail	One tail	Two tails
Result:			
Variable: Pilot's Speed	standing	Walking	running
Result:			
Variable: String Length	1 m	3 m	5 m
Result:			

12. Outside in a **clear area** [Ensure there are no power lines!], use your kite to test the variables. As you test these variables, record your observations and results in a data table and place in your lab notebook. Use a scale to rate the quality of flight under each different condition. For example, a scale of 0-10 where 0 is no flight and 10 is the best flight.
    a. **Tail Length**:
        1. Try flying the kite with a 10 cm tail make out of the plastic bag rings (you may need less than one ring to do this). Tape the tail to the ***bottom center*** of your kite, as shown in Figure 3. How well does the kite fly? What does the kite do? In your lab notebook, record your observations in your tail length data table.
        2. Make the tail have a 100 cm tail by looping rings together and gently

the kite. How does the kite with the 100 cm tail fly? Record your observations in your data table.

3. Make the tail have a 500 cm tail by gently looping more rings together. How well does the kite fly now? Record your observations.
4. With which tail length does your kite fly the best? Why do you think one tail worked better than the others?

Kite tail Figure. *When you attach a tail to your kite, attach it to the bottom center of the kite, as shown here with a 10 cm-long tail. If you attach more than one tail to your kite, attach the tails symmetrically on the bottom of the kite.*

b. **Number of tails**:
   1. Try flying the kite without a tail. What does it do? In your lab notebook, record your observations in your data table on number of tails.
   2. Attach one tail to your kite, as you did in step 13 a. How does the kite fly now? Again, record your observations.
   3. Remove the tail and add two tails symmetrically to the lower back of your kite. How does the kite fly now? Again, record your observations.
   4. With what number of tails did your kite fly best? Why do you think this is?

c. Pilot Speed [no tails]:

1. Using no tails, try standing still with your kite. What does it do? In your lab notebook, record your observations in your data table on flier speed.

2. Try walking with your kite. What does it do? Again, record your observations.
3. Try running with your kite. What does it do? Again, record your observations.
4. With what flier speed did your kite fly best? Why do you think this is?

d. String Length [using no tails]:

1. Fly your kite with the 1 m of kite string already attached to it. How well does it fly? What does it do? In your lab notebook, record your observations in your data table on string length.
2. Make your kite string 3 m long. How well does the kite fly now? Again, record your observations.
3. Make your kite string 5 m long. How well does the kite fly now? Again, record your observations.
4. With what string length did your kite fly best? Why do you think this is?

13. Based on your results, what do you think is the best tail length, number of tails, pilot speed, and string length for flying your kite? Why do you think this is? Can you relate your results to the forces of lift and drag on the kite?

Competition Kite

- Use your experience with the sled kite to begin designing your competition kite. Your competition kite should be the most aerodynamic flying kite possible using straws for the support system. Go to the library to find books or magazines about kite making, or use the Internet to find plans for making different kinds of kites. You should take notes during your research to include the types of forces that are important to launching and flying a kite. You should determine what type of kite that will be the best to make based on the materials you are permitted to use. You should sketch your idea for the best flying kite and show the forces that you will need to address to fly the kite. You should also determine the kite's mass and calculate the kite's force due to gravity. You may test your competition kite design using the same sets of variables. Are the same variables or are others important for flight of your chosen competition kite design? The aerodynamic flying ability of your kite design will compete with the designs of your classmates during our field trip to Jockey's Ridge. **Competition Rules will be included at the end of the assignment.**
- NOTE: Plan to allow ~four hours plus drying time; best to run in multiple sessions to permit glue drying between sessions.
- You can use the online kite flight simulator from NASA to test the variables of kite flight virtually. You can go directly to NASA's kite simulator page with this link: http://www.grc.nasa.gov/WWW/K-12/airplane/kiteprog.html

- You can also use the flight simulator to design a kite before you build it. Check out the Science Buddies experiment, The Wright Stuff: Using Kites to Study Aerodynamics

Kite Research Paper:

A neatly written or typed paper should be prepared that answers all questions asked during the assignment. The paper should also summarize the data collected from the sled kite research as well as your own research. Include what factors influenced the flight of your kite. Please use the scientific terms! Also summarize what influenced your choice for competition design and the materials that you were allowed to choose. This paper does not need to be lengthy, however, it must include the items listed above.

Resources: *[These are suggestions only. You may use other sources—please, remember to site all sources.]*

On this webpage you will find instructions to make a simple sled kite using drinking straws and a paper bag from the Dryden Flight Research Center at NASA:

- National Aeronautics and Space Administration (NASA). (2004). *Sled Kite.* Dryden Flight Research Center. Retrieved August 22, 2012, fromhttp://www.nasa.gov/pdf/205712main_Sled_Kite.pdf

From different webpages on the NASA website, you can read about the aerodynamics of kite flying:

- Benson, T. (2008, July 11). *Kites*. Glenn Research Center: National Aeronautics and Space Administration (NASA). Retrieved October 24, 2006 fromhttp://www.grc.nasa.gov/WWW/K-12/airplane/kite1.html
- Benson, T. (2008, July 11). *Forces on a Kite*. Glen Research Center: National Aeronautics and Space Administration (NASA). Retrieved August 22, 2012, from http://www.grc.nasa.gov/WWW/k-12/airplane/kitefor.html

You can do further research on how to make kites by visiting the following websites:

- My Best Kite. (n.d.) *Making Kite Tails.* Retrieved August 22, 2012, from http://www.my-best-kite.com/kite-tails.html
- Kites in the Sky. (n.d.) *How to Attach Kite Tails.* Retrieved August 22, 2012, from http://www.kitesinthesky.net/resources/kite-tails.php

News Feed on This Topic

Kite Science, *Science Buddies Blog*, April 1, 2010

The energy of stunt kites, *EurekAlert!*, November 12, 2012

Paper Rocket Aerodynamics, *Science Buddies Blog*, November 12, 2015

Project Source:

Science Buddies Staff. "Let's Go Fly a Kite!" *Science Buddies*. Science Buddies, 30 June 2014. Web. 1 Apr. 2016 http://www.sciencebuddies.org/science-fair-projects/project_ideas/Aero_p016.shtml

Name: _____ Date: _____ Class: _____

Design and Fly a Kite Activity—Construction and Competition Rules

https://www.teachengineering.org/view_activity.php?url=collection/ucd_/activities/ucd_kite/ucd_kite_activity1.xml

Description

Competitors should research and build the most aerodynamic flying kite possible, using straws for the support system. You should take notes during your research to include the types of forces that are important to launching and flying a kite. You should determine what type of kite that will be the best to make based on the materials you may use. You should sketch your idea for the best flying kite and show the forces that you will need to address to fly the kite. You should also determine the kite's mass and calculate the kite's force due to gravity. You will test your kite's ability to fly on Jockey's Ridge during our field trip. Plan to allow ~four hours plus drying time; best to run in multiple sessions to permit glue drying between sessions.

Event preparation:	Prepare entry prior to the competition
Class:	Physical Science
Team size:	2-4 students per team
Maximum # of entries/group:	1

Materials

M.1 Disposable plastic drinking straws with a minimum 7-inch length
M.2 Any kind of string, yarn, line, rope, etc.
M.3 Any kind of tape or adhesive
M.4 Any sheet material: paper, plastic film, cloth, etc.
M.5 A handle for the kite pilot

Construction Rules

C.1 Only materials described in M.1-5 may be used to build the competition kite.
C.2 After a completed kite is turned in prior to the event, no further work may be performed on it.
C.3 Each individual kite must have a minimum of 2 straws that are internally tied together, and at least one side covered by your chosen sheet material.
C.4 The sheeting material must be attached to the support frame.
C.5 There is no minimum size requirement for the kite. All kites must fit within an individual seat of a school bus. Your imagination is the limit on design type.
C.6 No "tails" are permitted.

Competition Rules

R.1 The judges weigh each kite, including its bridle. Note: A kite bridle is the arrangement of any strings placed between the kite and its flying line; used to hold the kite at a certain angle to the flying line to improve how the kite flies.
R.2 Each kite may have only one pilot who receives one attempt to fly, with time based on the competition schedule. Launching may be from the ground or with an assistant.
R.3 Flying is defined as the kite increasing in altitude, at least above the outstretched arm of the pilot, either due to wind or the pilot running.
R.4 For flying kites, judges will determine the kite that reaches the highest altitude and has the longest duration of flight.

Scoring and Awards

S.1 Awards will be given for flying kites based on: the highest altitude and the longest duration of continuous flight.

S.2 In the case of a tie, the lighter kite wins.