NATIONAL MUSEUM
OF THE UNITED STATES AIR FORCE™

Kites and Trigonometry

Students will work in teams of three to practice vector quantities and trigonometric functions by constructing and flying kites.

LESSON PLAN

Learning Objectives:

The students will:
- Build and fly kites
- Apply vectors
- Apply trigonometric functions
- Measure angles and distances
- Graph the results

Purpose:

This class is designed to give students the opportunity to practice skills in vector quantities and trigonometric functions by constructing and flying sled kites – thus providing a real-world example of mathematics' practicality in everyday life and work in a fun format.

Introduction:

Students will use a protractor device (see resource section) to estimate the angle the flying line (hypotenuse of the imagined triangle) makes with the ground, measure the distance from the Pilot to a point directly under the kite (adjacent side), and apply the formulas for sine and cosine to calculate the height of the kite (opposite side). They will convert these calculations to vectors and draw a vector diagram of the kite flying experience.

The sled kite is suggested as it is a standard workshop kite that can be made in a variety of sizes and with a variety of materials. The kite is simple to make and is an excellent flyer. Instructions for building and flying sled kites are available online. See the resource section for some options. Also be sure to note flying safety precautions and information on wind conditions as provided by the American Kitefliers Association.

Grade Level: 9 – 12

Ohio Learning Standards/Mathematics (2017)

Number and Quantity
N.VM.1: Recognize vector quantities

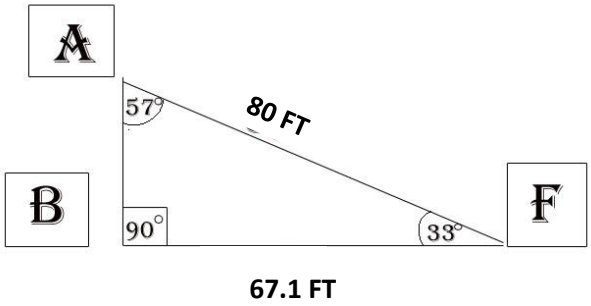
Geometry
G.SRT.6: Trigonometric ratios
G.SRT.7: Use relationship between sine and cosine
G.SRT.8: Solve problems involving right triangles

Materials Required:

- Materials as required according to the kite chosen to be built
- Measuring tape
- Measuring wheel
- Protractor
- Calculators

Procedure:

1) Vector Diagrams
   a) Point A is the kite
   b) Point B is the right angle
   c) Point F is the Flier
   d) Segment AF is the string and is marked in feet. (We will use 80 feet) – this is the vector **v**
   e) Measure of angle from the flier's hand (AFB) = 33° (therefore the measure of angle FAB = 57°)
   f) Segment BF = 67.1 ft
   g) Height of flier's hand is 5 feet



v sin AFB = segment AB
80 (sin 33°) = segment AB
80 (0.5446) = segment AB
43.571 = segment AB

v cos FAB = segment AB
80 (cos 57°) = segment AB
80 (0.5446) = segment AB
43.571 = segment AB

Do not forget to add the height of the arm holding the kite. Therefore, the kite is actually 43.57 + 5 = 48.57 feet high. As demonstrated, either the sine or cosine measurement can be used.

2) Ask the students if they can think of another way to find the altitude (segment AB)?
   a) The tangent of angle AFB = the segment AB divided by the segment BF
   b) Therefore: 0.649 = segment AB divided by 67.1
   c) Therefore: 0.649 times 67.1 = segment AB = 43.57 ft.

3) After building their kites, student teams will fly their kites to the predetermined length of string. One student flies the kite, another student determines the distance from the kite flier to the kite, and the third student measures the angle from the kite flier's hand to the altitude of the kite. Students return to the classroom and perform the above calculations.

4) Students should draw a diagram of the kite flying experiment. Label the distance of each side and the estimated angle between the flier's hand and the altitude of the kite

   a) Use the formula for the sine of an angle to determine the height of the kite

   b) Use the formula for the cosine of an angle to determine the height of the kite

   c) Represent the direction and distance in vectors

   d) Use graph paper to put the vectors on the coordinate plane

   e) Graph the results

Resources:

How to make an angle measuring device for tracking altitude:
https://www.grc.nasa.gov/www/k-12/rocket/TRCRocket/altitude_tracking2.html

Kite flying information and safety issues:
http://kite.org/

Kite building:
https://www.my-best-kite.com/how-to-build-kites.html
https://www.wikihow.com/Make-a-Kite
https://www.my-best-kite.com/how-to-make-a-sled-kite.html
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