NATIONAL MUSEUM OF THE UNITED STATES AIR FORCE™

Kite Meteorology

Students will work in pairs to practice weather and mathematical testing by constructing and flying kites with thermometers

LESSON PLAN

Learning Objectives:

The students will:

- Record temperatures at both ground level and kite-flying level for five days
- Compute the difference between the two temperatures each day
- Graph the temperature at ground level, the temperature at kite level, and the difference between the two temperatures
- Make conclusions about temperature and air based on the data collected in this lesson.
- Examine the history of kites and how kites have been used in meteorology

Purpose:

This class is designed to give students the opportunity to practice, understand, and build weather kites for meteorology testing. Students will learn how to calculate temperatures and determine temperature differences between ground and atmospheric levels, while simultaneously learning about the history of weather kite meteorology.

Introduction:

Students will use thermometers to record the temperature at ground level for five days. Also during those five days, a class kite with a thermometer attached to it will be flown in order to record a temperature at a higher altitude (50 feet). Students will be recording temperatures every day, and will be responsible for computing the difference between the two temperatures and graphing the data from day to day. Students will make predictions about what they will find before the activity and will draw conclusions at the end of the activity based on the data recorded. Also during this lesson, students will learn about the history of kites and how meteorologists have used kites to gather weather data.

NOTE: A 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. Also be sure to note flying safety precautions and information on wind conditions as provided by ***The American Kitefliers Association.***

Grade Level: 2-4

Ohio Learning Standards/Science (2018)

Expectations for Learning

Nature of Science

Earth and Science

2.ESS.1: Observation of air properties
2.ESS.3: Energy effects weather

Ohio Learning Standards/Mathematics (2017)

Ohio Standards for Mathematical Practices

MP.1: Make sense of problems
MP.2: Reason abstractly and quantitatively
MP.4: Model with mathematics
MP.5: Use appropriate tools strategically
MP.7: Look for and make use of structure

Number & Operations Based in Ten

2.NBT.7: Add & subtract within 1,000
3.NBT.2: Fluently add & subtract within 1,000
4.NBT.4: Fluently add & subtract multi-digit whole numbers using standard algorithm

Measurement & Data

4.MD.4: Display and interpret data in graphs

Geometry

4.G.1: Draw diagrams

Ohio Learning Standards/Social Studies (2018)

History Topics Grades K – 8

Historical Thinking and Skills
Heritage

Materials Required:

- 1 sled kite with flying line (see "Sled Kite" pages: 5-6 construction directions)
- 10 thermometers (or enough for each pair of students)
- 12" of string to attach thermometer to sled kite
- 1 data sheet for each student
- 3 graphs for each pair of students

Background:

a. Over 250 years ago meteorologists in Europe were using kites to carry thermometers aloft and record upper air observations.

b. By the late 1890s, the U.S. Weather Bureau had also begun regular kite observations.

c. The Weather Bureau's "box kites" towered over 6 feet tall, and strong, thin piano wire attached to a steam-driven reel held them in place.

d. Meteorological instruments known as "meteorographs" attached to the kites recorded pressure, temperature, and relative humidity data on an automated clockwork driven chart recorder.

e. Disadvantages Ex:
   - The kites could only reach an altitude of less than 2 miles, which limited their ability to take observations in the upper layers of the atmosphere.

f. By 1933, the advent of aircraft carrying meteorographs completely ended routine kite observations.

g. The inability of kite and aircraft meteorographs to reach higher layers of the atmosphere, fostered the development of the first radio transmission upper-air data.

Procedure:

A. Warm-up

1. Give a brief history lesson (see Background) about kites and how they have been used in meteorology.

2. Review with students how to read a thermometer correctly and how to care for it safely.

3. Divide class into pairs.

4. Explain the following activity and have students predict what the temperature is at ground level and at 50 feet above ground.

B. Activity

The following steps will be completed every day for five days:

1. Each pair of students will sit on the ground and measure the temperature with the thermometer. Record temperature on data sheet.

2. On the first day, the teacher will demonstrate how to fly the kite with the thermometer attached. The kite string will be released 50 feet, which has already been marked on the flying line with a red marker. Due to the angle at which the kite is flying, the kite will not be 50 feet from the ground, and the height will vary day to day. It should provide a sufficient difference in temperature for purposes of this lesson.

3. Allow the kite to fly at that level for five minutes. During this time have the students line up in pairs underneath the kite about three feet apart.

4. After the five minutes, the students closest to the teacher will gently grab the flying line and pull it toward the ground. Each pair of students will do this after the pair next to them has done so. The last pair should gently grab the kite and read the temperature on the thermometer for the class. Thermometer 10" string tow point.

5. Lay the kite and flying line down gently. Record temperature on data sheet.

6. Return to the classroom and compute the difference between the two temperatures (ground and air) and complete the data sheet.

C. Wrap-up

1. After recording data for five days, students will complete the data sheet and graphs. Ask students to make conclusions based on the data that they have recorded. Were they close to their predictions?

2. Discuss what students concluded and/or predicted. What have they learned about air and temperature? Why is this so? Is using a thermometer attached to a kite a good way to record temperature? How do meteorologists today record higher altitude temperatures?

3. Make a list of any questions relating to meteorology for a future visit to a local meteorologist.

Assessment/Evaluation:

Students should be evaluated on accuracy of computing differences and completing the graphs. Conclusions should relate to data collected.

Extensions:

1. Do this activity for a week in the fall and a week in the spring. Compare and contrast the data.

2. Fly three different kites at three different altitudes and record temperatures.

Resources:

Weather Kite History:
https://www.ncdc.noaa.gov/news/picture-climate-what-can-we-learn-kites
http://www.kitehistory.com/Miscellaneous/meteorological_kites.htm#:~:text=The%20first%20recorded%20weather%20experiments,would%20last%20for%20two%20centuries.

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

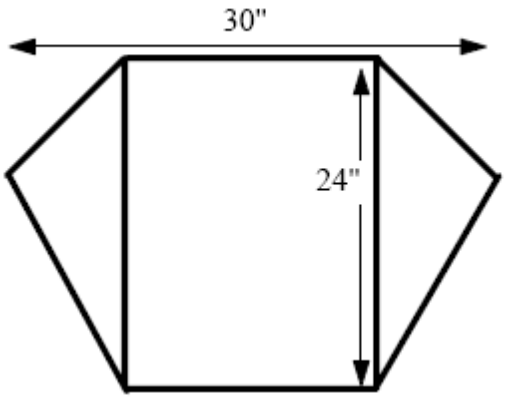
American Kitefliers association safety/field guidelines:
http://kite.org/education/field-guide/

Kite building:
https://www.my-best-kite.com/how-to-make-a-sled-kite.html
https://www.kiteplans.org/planos/MBKsled/make-a-sled-kite.html
https://reeddesign.co.uk/pdf/sled.pdf
https://www.nasa.gov/pdf/205712main_Sled_Kite.pdf

Sled Kite Proportions
Student Instruction Sheet

1. Compute the measurements for the size of the kite that you are going to make. Make a paper pattern.

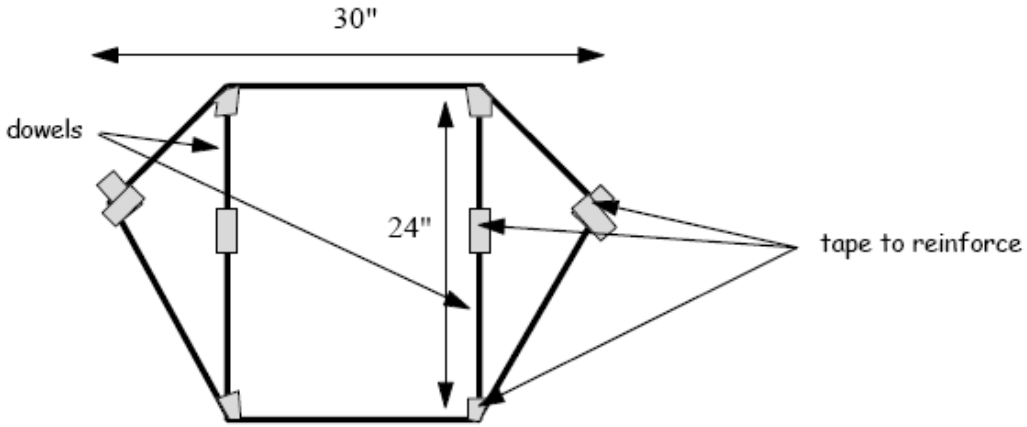
2. Trace the pattern onto the plastic garbage bag. Example:



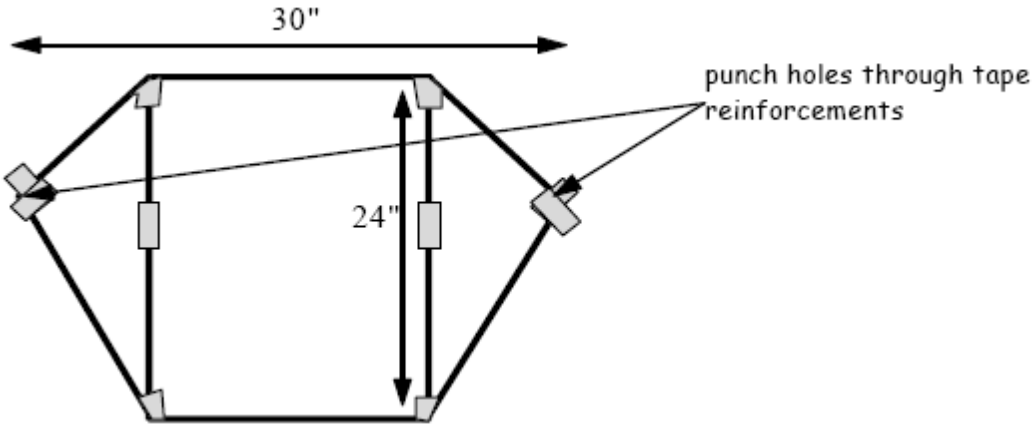
3. Cut out your kite. Look for symmetry in the kite.

4. Cut the dowel rods to the appropriate lengths with a pair of wire cutters or a small saw. It is important to make accurate measurements before cutting.

5. Tape the dowel rods into place. Cut tape into approximately 2" sections. Place a piece of tape lengthwise on the center of the dowel rod then tape to the material. Place about half of the length of tape at each end of the dowel. Tape the dowel to the material then fold the remaining tape over and attach to the other side of the material. Tape the corners with two pieces of 2" tape on the outermost corners as shown below. The tape should fold back and attach to the other side of the material.



6. After the tape is applied, punch a hole through both corners at the same time. The tape is there to reinforce these corners.



7. Cut a length of string 5 times the length of the dowel rod. Tie the string through the holes using a square knot. Bring the holes together and find the exact midpoint of the string. Tie a knot, leaving a small loop. It is very important that this loop is exactly in the center. If it is not, the kite will not fly straight. Now, tie your flying line in the loop and you are ready to fly!