

Exploring Surface Winds Using Mini-Kites

(Submitted by the AREN Project)

Purpose

To help students explore surface winds.

Overview

Students will make and fly a mini-kite to explore surface winds.

Student Outcomes

Students will make a mini-kite with a string length of less than a meter. Students will fly a kite to explore local surface winds.

Science Concepts

Earth Science

- Wind

Physical Science

- Forces
- Motion of Objects

Science Practices

- Planning and carrying out an investigation
- Constructing explanations

Cross Cutting Concepts

- Cause and Effect
- Structure and Function
- Patterns

NGSS Alignment

- K-ESS2-1, K-PS2-1, K-PS2-2
- 3-ESS2-1, 3-PS2-1, 3-PS2-2
- MS-ESS2-5, MS-PS2-2

Time

45 - 60 minutes

Grade Level

K-5
6-8
9-12 (Optional as a 5E Engagement Activity)

Materials and Tools (Per Student)

- 50 mm X 75 mm Tissue Paper Rectangle
- Scissors
- Ruler
- Pen
- Pencil
- 6 mm diameter Sticker Dots or pieces of Tape - 3 per kite
- 61 cm piece of Thread
- 2 pieces of materials for kite tails -- 6 mm X 30 mm each (smaller length for K-2 students) (ideas: streamers, ribbon, tissue paper, or tinsel, etc.)
- Large straw or 25 cm dowel stick

Preparation

- Prepare and organize kite materials for student access
- Determine a location for assembling kites
- Determine and reserve a location to fly with appropriate available space. Request permission to fly if needed.
- Determine necessary safety considerations for the materials used and flight location.
- Make a kite using available materials as a sample.

Prerequisites

None

Background

Wind

Wind is a current of air created by uneven heating that moves along or parallel to the ground, from an area of high pressure to an area of low pressure. Surface **Winds** are the **winds** that exist close to the Earth's surface, less than 10 meters from the surface of the Earth. Upper air winds, greater than 10 meters from the surface of the Earth, are faster than surface winds because there is less friction.

NASA uses satellites to remotely study global winds. This is because global winds circulate air and redistribute energy and regulate the Earth's temperature. Mini-kites can help us learn about the motion of surface winds. The **mission** goal of this activity is to use a mini-kite to explore surface winds at a study site.

Surface wind is often measured quantitatively by anemometers, or wind meters, but it can also be measured qualitatively by its effect on trees, kites, and other objects. One way to characterize wind speed is with the Beaufort Scale that associates wind ranges with the effect on objects in the local environment.

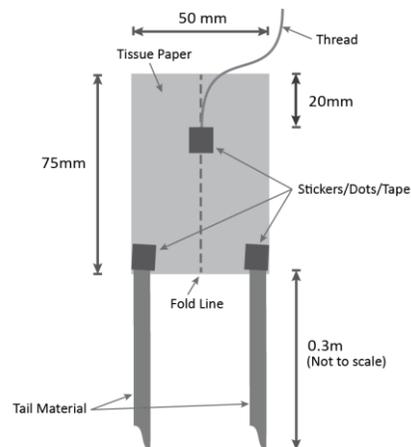
Beaufort Number	Wind Speed (miles/hour)	Wind Speed (km/hour)	Wind Speed (knots)	Description	Wind Effects on Land
0	< 1	< 1	< 1	Calm	Calm. Smoke rises vertically.
1	1-3	1-5	1-3	Light Air	Wind motion visible in smoke.
2	4-7	6-11	4-6	Light Breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	12-19	7-12	Gentle Breeze	Leaves and smaller twigs in constant motion.
4	13-18	20-28	11-16	Moderate Breeze	Dust and loose paper are raised. Small branches begin to move.
5	19-24	29-38	17-21	Fresh Breeze	Small trees begin to sway.
6	25-31	39-49	22-27	Strong Breeze	Large branches are in motion. Whistling is heard in overhead wires. Umbrella use is difficult.
7	32-38	50-61	28-33	Near Gale	Whole trees in motion. Some difficulty experienced walking into the wind.
8	39-46	62-74	34-40	Gale	Twigs and small branches break from trees. Cars veer on road.
9	47-54	75-88	41-47	Strong Gale	Larger branches break from trees. Light structural damage.
10	55-63	89-102	48-55	Storm	Trees broken and uprooted. Considerable structural damage.
11	64-72	103-117	56-63	Violent Storm	Widespread damage to structures and vegetation.
12	> 73	> 117	> 64	Hurricane	Considerable and widespread damage to structures and vegetation. Violence.

Preparation

- Make one standard kite to show as an example and practice lofting it through the air.
- If under a time constraint or working with younger children, consider cutting out the tissue paper kite body and tails beforehand.
- Identify an outdoor flight area.

Directions

1. Cut out a piece of tissue paper to size 5 cm x 7.5 cm for the kite body and two tails 6 mm x 30.5 cm.
2. Cut a 61 cm piece of thread.
3. Fold the kite body in half lengthwise to form a crease.
4. Open the kite back up with the crease pointed up.
5. Measure 19 mm from the top of the kite along the fold and draw a small x.
6. Using the sticker dots/tape, attach one end of the 61 cm thread to the kite on the x.
7. Use two more pieces of sticker dots/tape to attach the two tails at the bottom corners of the kite, as shown in the diagram.
8. Connect the unattached end of the thread to the end of the large straw or stick.
9. Hold the straw or stick up in the air and observe the motions of the kite in the wind.



Safety/Operations

The **mission** of flying the kite is to study surface winds at our study site. Make sure that students

What to do / How to do it

are clear of the **mission** of the flight. It is important that students understand how to be safe at the flight location and during the transfer from the classroom to the flight location. During flight, students must be at least two meters apart from each other. No running or yelling is permitted. Hold a discussion (**post flight debriefing**) after everyone has flown a kite.

Appropriate wind conditions are crucial for successful kite flying. Most kites come labeled with an ideal wind range that is safe and appropriate for that specific kite. The mini-kites in this activity are not meant to fly in upper air winds, so they are not labeled with an ideal wind range.

Questions for Discussion

1. What did you learn about the wind?
*The wind **lifts** the kite. Wind can blow in many directions. The wind can start and stop. The wind has varied strengths. The wind moves objects.*
2. What did we learn about the surface winds using mini-kites at our study site?
*The winds can blow in different directions (**variable** winds). The wind can start and stop. The wind can **lift** the kite. Students may notice a difference in how the wind affects kites closer to the ground compared to higher levels above their head.*
3. Compare and contrast how the kite flew in an open field as compared to when it flew by a tree or other object that obstructed the wind?
In an open field, the wind blew and kept the kite stable in the air. When a tree got in the way, flying became unstable and the kite came lower to the ground.
4. How would you describe your flight, using words or pictures?



Students (such as Kyle Lee) are encouraged to use words, pictures, and/or arrows to describe their flights in their own way.

4. What are the limitations and advantages of using mini-kites?
Limitations: String length; kite size; students can only study the air where the kite flies.
Advantages: Can study the effects of the wind, right before our eyes; can get a sense of wind strength and direction; can study the forces of flight, taking place; easy to build; and inexpensive.
5. How did you practice safety?
We followed directions, carefully carried our kite, safely distanced from others, observed the ground looking for ground hazards, did not poke others with the stick, and did not run.

Extensions

- Elementary students can study the pushes and pulls that affect the aerodynamics of kite flight.
- Middle School and High School students can study the various forces (lift, gravity, drag, friction, weight, and pull) that affect the aerodynamics of kite flight.
- Students can use tools to collect actual wind speed data, such as an anemometer.
- Students can design a modified Beaufort Scale for surface winds using objects in their study site area.

Definitions

Lift -- The air moving around the kite surface that sustains the kites flight

Mission -- An important task

Post Flight Debriefing -- Participant discussion of the successes and challenges of the field mission

Variable winds -- Moving air that changes by either direction or speed

Wind -- Moving air

Special Thanks to Glenn Davidson, Charlie Scotch, Susie Jo Skinner and Kay Rufty for their contributions to mini-kite design and use.