



KITE LIGHT FLIGHT

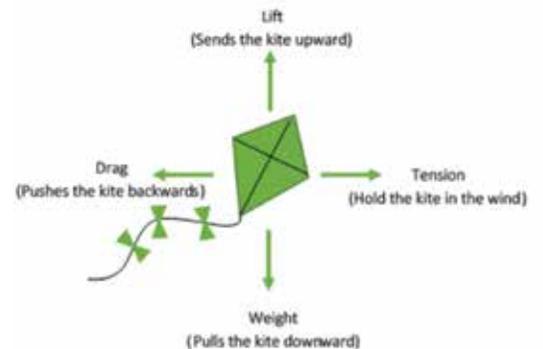
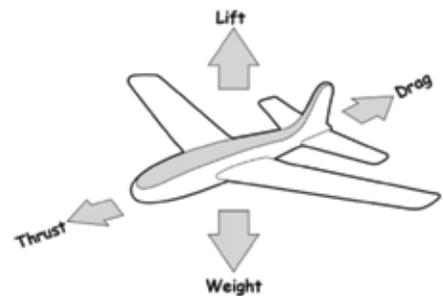
Nice weather is the perfect excuse to take STEM outdoors. **THIS STEM GEM PROVIDES A SIMPLE ACTIVITY THAT YOU CAN SAVE FOR A CLEAR AND WINDY DAY, CHALLENGING YOUNG PEOPLE TO TAKE FLIGHT AND LEARN ABOUT KITES.** Kites are among the earliest man-made flying objects, dating back at least 2,500 years to a military general in ancient China. The general flew a kite over a battlefield, then measured the string to determine how long to make a tunnel that his troops were digging. As kite flying spread, so did the reasons for flying them. These days, kites are flown for entertainment, kite-fighting competitions, target practice, fishing, weather forecasting, and scientific experiments.

WHAT FORCES ARE INVOLVED IN FLIGHT?

Four forces act on all flying objects—thrust, drag, lift, and weight. To move forward through the air, some kind of thrust (push) is required. As a flying object moves forward through the air, drag, a force caused by air resistance, slows it down. The faster an object moves forward, the greater the force of drag. An object's thrust has to be greater than the amount of drag pulling it back for it to fly. Moving forward is not enough to fly, there also needs to be a force that lifts an object into the air. The upward force of lift has to be greater than the downward pull of gravity due to an object's weight. An object will fly only when its lift and thrust are greater than the drag and weight.

HOW DOES A KITE FLY?

Kites rely on the energy of the wind to fly. In order to fly, a kite must generate enough lift to overcome its weight. This is where the wind comes in. When the sail of a kite is angled into the wind, the moving air hits the sail and pushes it upward, providing lift. However, once the kite is airborne, its large sail catches the air and this causes drag, a force that pulls the kite backward. To counteract drag, the person flying the kite anchors it, or provides tension, by pulling and releasing the kite's strings. Kites are able to fly when the forces of weight, lift, drag, and tension are all in balance.



SCIENCE talk

BRIDLE

The part of a kite that keeps it at the proper angle in the wind to create lift.

DRAG

A force caused by friction that opposes motion.

FORCE

A push or a pull.

KITE

A light frame (often made of wood), covered with paper or plastic, and attached to the end of a long string.

LIFT

A force that pushes up on objects.

SAIL

The body of a kite.

TAIL

A banner, ribbon, or tassel attached to the end of a kite to provide stability.

WEIGHT

The measurement of how heavy something is.

engage

- ?** **What kinds of things fly?** *Young people's choice; suggestions may include birds, bats, kites, gliders, airplanes, helicopters, hovercrafts, or rockets.*
- ?** **Have you ever flown a kite? If so, what did the kite need in order to fly?** *Kites need wind, or air movement, to fly.*
- ?** **Why do people fly kites?** *For pleasure, experiments, and for obtaining weather information.*

what YOU WILL NEED

- !** Large, open outdoor area
- !** Kite template
- !** Paper (1 sheet per young person)
- !** Drawing utensils
- !** Hole punch or pencil
- !** Lightweight string (2 feet and 6 inches per young person)
- !** Scissors
- !** Straws (3 per young person)
- !** Tape
- !** Optional: Paper and string to create tails

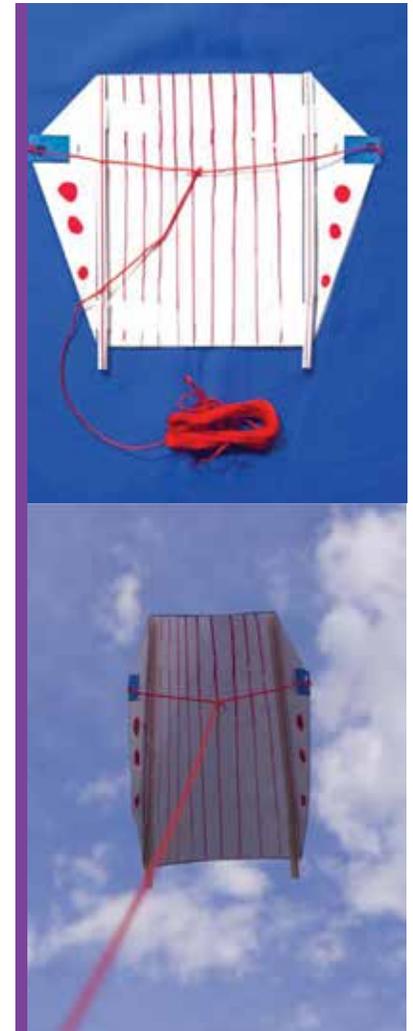
& before YOU BEGIN

1. Print a copy of the kite template for every young person.
2. Cut the string into one six-inch length and one two-foot length for every young person.



EXPLORE & EXPERIMENT

- 1** **Pass out a copy of the kite template to each young person.** Have young people cut out the templates to form the sail of their kites.
- 2** **Instruct them to use two small pieces of tape** to cover and reinforce the circles on the wingtips of the kites.
- 3** **Invite each young person to collect two straws** and tape the straws to his or her kite as shown on the template. If the straws are too long, instruct young people to position them so they are even with the top and hang past the bottom of the kite.
- 4** While the group tapes their straws to their kites, **help each young person poke a hole through the center of each black circle** using a hole punch or pencil.
- 5** **Have each young person gather a six-inch piece of string** and tie one end through each of the holes in the two wingtips. This will form the bridle of the kite.
- 6** **Invite each young person to gather a two-foot piece of string and an additional straw.** Have young people tie one end of the long piece of string to the middle of their kite's bridle and other end to the straw. The straw can be used as a reel to wrap excess string around.
- 7** **Provide the group with drawing utensils** and allow them time to decorate their kites.
- 8** **Take the group to a large, open outdoor area** where they can fly their kites.
- 9** **Have young people spread out around the area and try to briefly pull their kites through the air.** Ask them to describe what they felt as they pulled their kites. Everyone should have been able to feel the force of drag from the sail while experiencing a small amount of lift.
- 10** **Discuss the appropriate kite-flying safety rules for the space with the group.** Then have young people spread out and attempt to fly their kites. After a few minutes, gather the group and discuss the tactics that worked the best for keeping their kites airborne.
- 11** **Invite young people to discuss why it is better to fly their kites into the wind.** Have young people describe what forces affected the flight of their kites.
- 12** **Explain to young people that kites must overcome gravity to fly.** The large surface area of a kite's sail generates lift. Wind blowing against the sail provides the force to keep the kite airborne. The bridle, that attaches the tether to the kite, holds the kite's sail at the optimal angle to generate lift. As the kite starts to fly, the large area of the sail produces



EXPLORE & EXPERIMENT (continued...)

drag. Drag acts as a force that pulls backward on the kite. The person holding the string attached to the bridle creates tension by pulling on the tether line to keep the kite airborne and at the correct angle; thus, balancing the force of drag so the kite does not fly backward. Thrust is often needed to get a kite airborne, which is provided by pulling the kite forward quickly through the air.



Discuss with young people what they think they could do to the design of the kite to improve its performance.

If they find their kites are spinning in the wind, ask them what they could add to their kites to help with this problem. Explain that adding a tail to a kite provides downward drag that can help it stay upright in the air.



If time allows, invite young people to experiment with different tail designs to discover what works best. Small tails taped to the bottom of both straws on the wingtips seems to provide the best stability. Encourage young people to make kite tails by taping small paper strips to string and attaching the string to their wingtips.

make THE CONNECTION

Have young people make a list of things that fly. Invite the group to think about and discuss how each item they listed maximizes thrust and lift while minimizing drag and weight.

Share the example of how an airplane uses each type of force to fly.

THRUST: Airplanes use big jet engines or propellers to push or pull them through the air.

LIFT: Airplanes use large, specially shaped wings that cause the air to push the aircraft up as they move through the air.

WEIGHT: Airplanes are made of lightweight materials such as aluminum to keep weight to a minimum.

DRAG: Aircraft are made to be very streamlined so they cut through the air with minimum drag.



EXTEND & EVALUATE

Invite young people to use glue, tape, scissors, and available craft materials to design and build their own kites. Appropriate materials include plastic bags, tissue paper, wooden dowels, string, straws, and paper. Have young people think about how they can maximize lift while minimizing drag and weight with their designs. Finally, invite them to test their kites. Ask each young person how he or she could improve his or her design to make the kite fly better. If time allows, encourage young people to make adjustments to their designs and test the re-designed kites to find a design that flies the best.