Introduction to Flight

STEM CONNECTIONS

Engineering: Developing Possible Solutions

DURATION

60 minutes

MATERIALS

Page pockets (2 per group) containing:

- Not All Birds Fly Handout
- Sled Kite Directions

Sled Kite Templates (1 per student)

Clear tape dispensers (1 per group)

Paper clips (1 per student)

Scissors (2 per group)

Single hole punch (1 per every other group)

Straws (2 per student)

String (about 2 m per student)

Tape measure (1 per group)

SCHEDULE

- Welcome to Flight and Aerodynamics Camp (15 min)
- Discussion: Things that fly naturally and early attempts at flight (10 min)
- Sled Kites (30 min)
- Wrap Up (5 min)

OBJECTIVE

Introduce students to the early history of attempts at flight.

ALIGNED STANDARDS

Next Generation Science Standards (NGSS)*

NGSS 3-5-ETS1-1: Engineering Design

HABITS OF MIND

- Managing Impulsivity
- Persisting

21ST CENTURY SKILLS

- Initiative and Self-Direction
- Social and Cross-Cultural Skills

BACKGROUND INFORMATION

People have been interested in flying for a very long time. Cultures from around the world tell stories about people who could fly or tried to fly. In the Ramayana, an Indian epic poem, the demon king Ravana has a huge flying vehicle which he travels around in. One Thousand and One Nights, a collection of Middle Eastern and South Asian folklore, features a magical carpet which can fly or teleport anyone who sits on it.

These stories often include someone using birds to fly, or constructing bird-like wings for themselves. In Persian mythology, the king Kay Kavus attached poles to his throne: at the bottom of the poles he tied hungry eagles, and at the top he put pieces of food. The eagles flew upward, trying to get the food, and lifted his throne off the ground. One of the best known stories is the Greek legend of Daedalus and Icarus, a father and son who were imprisoned in a tower and used bird feathers to build wings for themselves and fly away. The feathers were stuck together with wax, though, and when Icarus flew too close to the sun the wax melted and his wings fell apart, dropping him in the sea.

The first real flying machines people invented were kites. They originated in China about 2500 years ago, and quickly spread across Asia. In China, India, Korea, and other countries, kites have been used for a wide range of purposes, including sending messages during war, religious ceremonies, competitive kite-flying where players try to cut each other's kite strings, and entertainment.

Leonardo Da Vinci:

Leonardo Da Vinci was an Italian artist, inventor, and scientist who lived in the 14- and 1500s and drew many early designs for flying machines. He was among the first to propose helicopters, parachutes, and even a design for a human-powered plane with wings that flapped like a bird's. We now know that not all of his designs would be able to fly, but they were an important inspiration to many people who came after him. Like many early conceptions of flight, Da Vinci's were based heavily on the way that birds flew.

Imitating Birds:

Other people during Da Vinci's life, as well as before and after, actually built wings for themselves and attempted to fly with them. Giovanni Battista Danti, a contemporary of Da Vinci, built himself metal wings like a bird, climbed to the top of a church, and tried to fly off. However, it didn't work and he fell and broke his leg. Paolo Guidotti was another Italian, about a century later, who built himself wings out of whalebone and bird feathers. He managed to glide for some distance but then fell through a roof and broke his leg as well. Eilmer of Malmesbury, an English monk in the 11th century, was reported to have constructed wings and attempted to fly off the top of his abbey, gliding a considerable distance before eventually falling and breaking both his legs.

Clearly, early attempts at flying involved significant danger. People at the time had not yet discovered the principles behind flight, so they usually based their designs on the way that birds flew. The problem is that birds are naturally adapted to flying, and have very strong wing muscles and very light bodies that allow them to do so. Humans are pretty heavy and don't have especially strong arm muscles, which means that it's very difficult for us to fly using only our own power.

OVERVIEW

Today introduce students to camp as learn about early attempts at flight and build sled kites. In the discussion of naturally flying creatures and early attempts at flight, campers consider how the shapes of different flying animals allow them to fly, and how early inventors tried to mimic those animals to build flying contraptions. Then in making a kite, they connect with one of the earliest successful modes of flight.

DAILY PREP

- Using your roster of campers, create assigned groups for small-group activities - up to 8 groups of 3-4 students who will work together all week. Try to mix genders and grade levels in each group, if you can. Number or name each group.
- Cut 2 pieces of string to 45 cm, and one piece to 1m per student, or plan to have students do this themselves during the Sled Kite Activity.
- The plastic tubs included in the kit can double as supply caddies for each group. Today each group needs:
    - Clear tape dispenser
    - Paper clips (1 per student)
    - 2 Scissors
    - Sled Kite Templates (1 per student)
    - Straws (2 per student)
    - String (2 45cm-long pieces and 1 1-m long piece per student)
    - Tape measure
- Spread the hole punches to every other group's kit
- Prep the Not All Birds Fly and Sled Kite Directions handouts in the page pockets.

STEP-BY-STEP DIRECTIONS FOR INSTRUCTORS

Whole Group

WELCOME TO FLIGHT

Welcome the campers, and share a few things you're excited about doing with them during this camp. Establish some basic ground rules, such as:

- Be respectful
- Be kind
- Be safe
- Try your best

This is a great time to add any specific "house" rules, such as:

- Ask to go to the bathroom or leave the room
- Things in the room they are allowed to touch/not touch

Have them sit in a circle and go around the circle sharing their name and what kind of flying object they would like to be - encourage them to think broadly, from leaves and birds to parachutes and planes and rockets.

> During this camp, we'll often be working in small groups, so now we're going to find out who's in our groups and get to know each other a little. When I've read your group's list, find a space in the room to sit together, and each person can remind everyone of their name, and then talk about why you picked the flying object you would like to be, or about why your favorite way of flying is your favorite.

Read each group number/name, and the list of campers, then break to sit together in new groups. When all have settled in, walk around to listen in on their conversations.

Group Discussion

THINGS THAT FLY NATURALLY AND EARLY ATTEMPTS AT FLIGHT

Get everyone's attention, and bring them back to a whole group to brainstorm things that fly in nature.

> Before humans had invented ways for us to fly, they looked to things that fly naturally for ideas.
>
> - What would be some examples? (leaves, birds, flying squirrels, bats)
>
> Early inventors looked at the shapes of flying creatures and tried to figure out how we could imitate that.

Pass out page pockets holding the handout with bird images and have students predict which ones can fly and which ones can't.

> Let's look at the shapes of these different birds, and make a prediction about which ones can fly, and which ones can't. If you think it can fly, yell out "FLY!". If you think it can't, yell out "FLOP!"

Read each bird's name, get their responses, then answer with whether it can/can't fly, from the reference on the following page. Then challenge the students to compare the flyers with the non-flyers.

> Did you notice any patterns about what kinds of shapes could fly? (Narrower from the front, big enough wings in proportion to body)

Next share some history on a few early attempts at flight.

> How do you think it went when early inventors tried to imitate birds? (Gather several answers)

Discuss a few early attempts at flight by telling stories of Leonardo Da Vinci and those who imitated birds. Either read from the background info above, or retell in your own words.

DAY 1

Flight and Aerodynamics

Not All Birds Fly

Not All Birds Fly Answers

Emu: Flightless

Bird of Paradise: Flighted

Arctic Tern: Flighted

Emperor Penguin: Flightless

Kiwi Bird: Flightless

Carroway: Flightless

Great Albatross: Flighted

Fruit Bat: Flighted (Bats are not birds, they are mammals and they can fly)

Independent

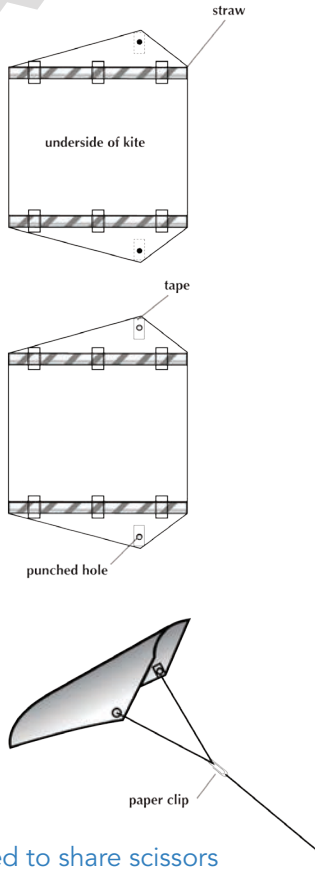
SLED KITES

One of the earliest successful flying objects people made was a kite. We're going to make sled kites today, which are one of the most common kinds of kites. The Wright Brothers, who built the first working airplane, spent years building and testing kites similar to these ones to help them understand how flight worked and how to control an object while it's flying.

Move to sitting at tables or desks if still in a circle. Introduce the project and have student volunteers pass out bins holding the supplies for making sled kites. Depending on your group, either walk students through the directions step by step or have them work independently using the handouts in the page pockets.

Sled Kite Directions

1. Carefully cut out the Sled Kite Template
2. Cut each of the straws so they match the length of the dotted lines on the template.
3. Tape the straws to the template. See image top image.
4. Cover each black dot with 2-3 pieces of tape.
5. Using a single-hole punch, punch a hole through each of the black circles.
6. Tie one 45cm-long string to each hole. Be careful not to tear the paper when pulling knots tight. See center image.
7. Tie a paper clip to the loose ends of both strings.
8. Tie one end of the 1m-long string to the other end of the paper clip and your kite is ready to fly! See bottom image.



Follow the directions on the handout to make your own kite. You'll need to share scissors with a partner and take turns with the hole punchers and tape dispensers.

Walk around and help students as needed. When most have finished, go outside if possible to test the kites. If not, use a hallway and have the students run with their kites. Before breaking, have the students make some predictions:

- What do you think will happen if you only walk? (it might not fly)
- What if you run very fast? (It will fly higher/faster)

Try running and walking at different speeds to test your predictions!

Come back to the classroom and gather together.

Group Discussion

WRAP UP

End with a quick discussion on kites and flight:

- How did your speed affect your kite's flight? (Faster movement helped it fly)
- Could kites be used to lift objects or people? (yes, e.g. parasailing)
- What kinds of materials can kites be made of? (Paper, fabrics, natural materials like bamboo and grass/leaves)
- Why do those materials work? (They are lightweight)

Tomorrow we will learn more about kites from around the world, and make some more beautiful and sturdy ones ourselves!

Have student volunteers collect tape dispensers, hole punches, and page pockets to use again. Have another student collect leftover bits of paper and toss those. Students can take home their kites!

CHECK FOR UNDERSTANDING

- What were some of the first experiments with flight? (kites, imitating birds)
- What aspects of birds' shapes help them fly? (streamlined shape, wing shape)
- How did your materials and movement help your kite fly? (lightweight materials are easier to lift, faster movement helped keep it up)

EXTENSIONS

Kite Relays

Ideally outside, assign partners and have each pair use one kite. Designate a start and finish line, and have one person from each pair line up along the start line, with their partners behind. Pulling their kites above them, they must run across to the finish line and back to their partner, hand off the kite to the partner, and have the partner run across and back without the kite ever hitting the ground. If the kite hits the ground, that person must start over. The first pair back wins. Alternatively, this could be done in small group teams - everyone on a team takes a turn with the kite, and the first team to complete the relay wins.

DAY 1

Introduction to Flight

Not All Birds Fly

Emu

Bird of Paradise

Arctic Tern

Emperor Penguin

Kiwi Bird

Cassoway

Albatross

Fruit Bat

DAY 1

Introduction to Flight

Sled Kite Directions

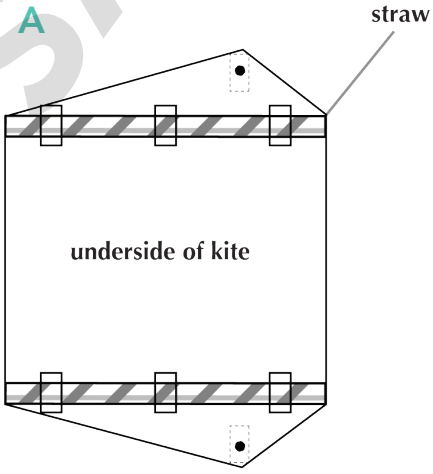
Materials:

- Sled Kite Template (1 per kite)
- Clear tape
- Paper clip (1 per kite)
- Scissors
- Single hole punch
- Straws (2 per kite)
- String (2 45-cm pieces and 1 1-m piece per kite)
- Tape measure

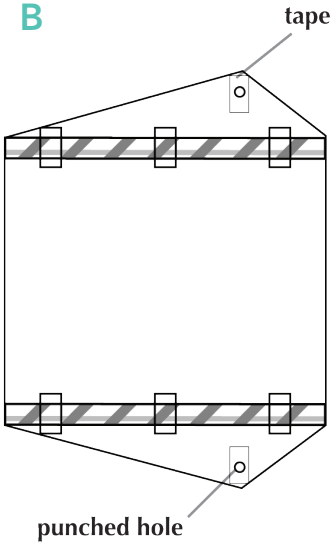
Directions

1. Carefully cut out the Sled Kite Template
2. Cut each of the straws so they match the length of the dotted lines on the template.
3. Tape the straws to the template. See image A.
4. Cover each black dot with 2-3 pieces of tape.
5. Using a single-hole punch, punch a hole through each of the black circles.
6. Tie one 45cm-long string to each hole. Be careful not to tear the paper when pulling knots tight. See image B
7. Tie a paper clip to the loose ends of both strings.
8. Tie one end of the 1m-long string to the other end of the paper clip and your kite is ready to fly! See image C.

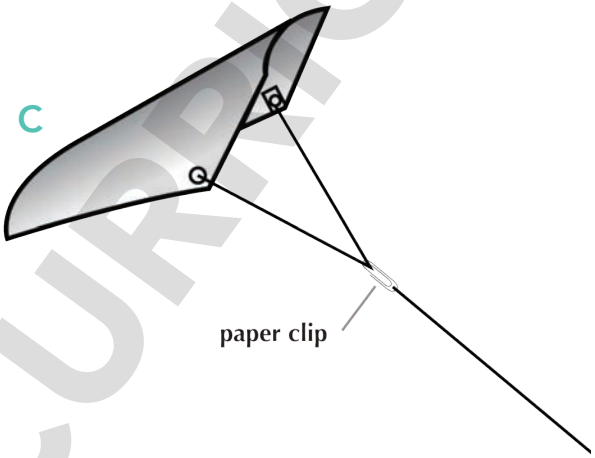
A



B



C



Images courtesy of NASA

DAY 1

Introduction to Flight

Sled Kite Template