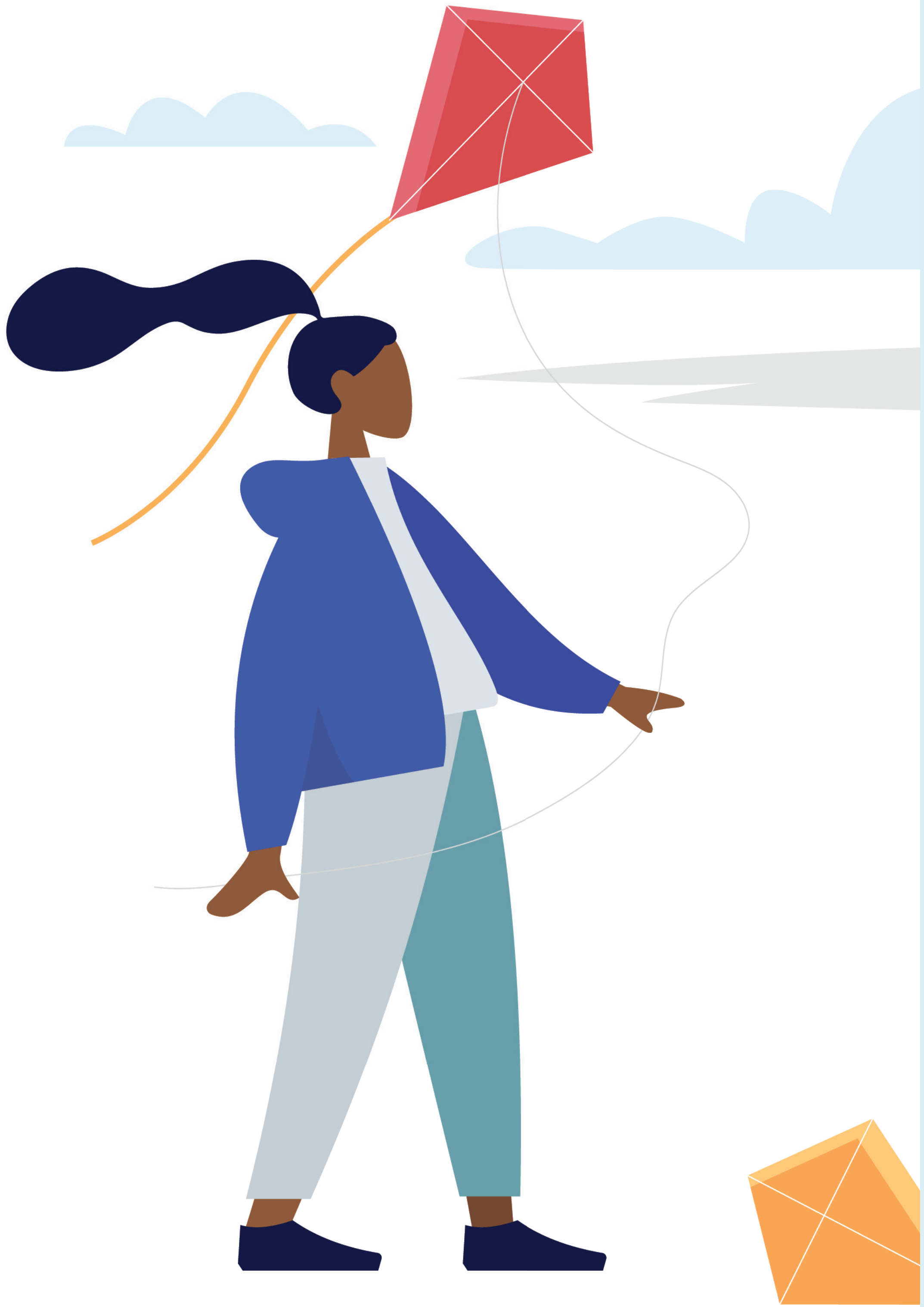

PRIMARY + STEM

Teaching Resource

ACTIVITY: Kites

ACTIVITY OVERVIEW

In this activity, focus is placed on the 'Investigate' and 'Generate' processes of the Creating Designed Solutions strand of the curriculum, where students make kites with different materials and styles to explore the elements of a good kite.

Kite enthusiasts in the class could even work towards combining the best of elements they've learnt about and generate their original kite designs.

SYNOPSIS

Although kites do not often feature largely in Australian history, many of us have experienced the joy of watching vibrant kites soaring in the sky. Through this activity, we hope that students tap into the celebration of the indominable human spirit that seeks to defy gravity in the skies.

Kites first flew in the skies when the Chinese invented them, more than 2,000 years ago. By the 1400s, the movement of traders saw this practice spread across Asia and the world. Today, we have kites in distinctive styles from different countries, such as the Malaysian wau, the Indonesian layang-layang, the Japanese rokkaku, and the Indian patang. Even the Wright Brothers, inventors of the first powered plane in 1903 in the USA, were skilled at kite-flying. In fact, they first built a large kite to test their design for wing stability and control before going onto designing a full-size piloted glider.

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Foundation – Year 2

- The way objects move depends on a variety of factors including their size and shape: a push or a pull affects how an object moves or changes shape (VCSSU048)
- Explore the characteristics and properties of materials and components that are used to create designed solutions (VCDSTC017)
- Use materials, components, tools, equipment and techniques to produce designed solutions safely (VCDSCD020)

Year 3 – 4

- Forces can be exerted by one object on another through direct contact or from a distance (VCSSU064)
- Explore the characteristics and properties of materials and components that are used to create designed solutions (VCDSTC017)
- Investigate how forces and the properties of materials affect the behaviour of a designed solution (VCDSTC024)
- Investigate the suitability of materials, systems, components, tools and equipment for a range of purposes (VCDSTC027)
- Select and use materials, components, tools and equipment using safe work practices to produce designed solutions (VCDSCD030)
- Evaluate design ideas, processes and solutions based on criteria for success developed with guidance and including care for the environment and communities (VCDSCD031)

Year 5 - 6

- Critique needs or opportunities for designing, and investigate materials, components, tools, equipment and processes to achieve intended designed solutions (VCDSCD038)
- Energy from a variety of sources can be used to generate electricity; electric circuits enable this energy to be transferred to another place and then to be transformed into another form of energy (VCSSU081)

ACTIVITY, MATERIALS AND INSTRUCTIONS

Activity

In this activity, students learn how kites work, then make and test them to explore what makes a good kite. The challenge is to create kites that are balanced and can follow the child around a room as the child pulls it along.

Materials for 30 students

- Sail: An assortment of different paper (e.g. A4 printing paper, gift wrapping paper, cardboard, and plastic bags)
- Frame: Paper straws, blunted bamboo skewers, etc.
- String: Cotton, crocheting cotton, yarn, nylon (at least four metres per student)
- Spool: Toilet paper cores, cardboard
- Tail: Ribbons, paper streamers, etc.
- Others: Adhesives (e.g. sticky tape, masking tape, duct tape), scissors, hole-punchers
- Tablets to view instructions to make kites
- Internet access

Theory

Parts of a kite

a. Kite body
 The body of the kite has a sail that should be light and strong. Depending on the kite design, it may or may not have a rigid frame.

b. The bridle
 The harness where the kite line is attached to the kite body.

c. The kite line
 This consists of the string and the spool, which is something to wind the string on. It could be as simple as a rectangular piece of cardboard, or a toilet paper core.

d. The tail
 Many kites have tails to help them keep balance as they fly.

Materials

Discuss the suitability of different materials that could be used to make different parts of the kite.

What are some favourable properties for constructing the sail?

--> *It ought to be light, strong, etc.*

What are some qualities that are not helpful for the kite?

--> *Paper that is too heavy, or that tears easily like paper towels, etc.*

Forces

When designing a kite, it is important to consider the many forces acting on the system, especially when it is flying.

What do students know about forces (pulls and pushes) that determine how objects move?

Forces act on objects and have direction, size, and they often work in opposites. Weight pulls objects downwards, lift pushes objects upwards, drag works opposite to the direction of motion, etc.

Use Figures 1 and 2 in the Discussion Section to show the different forces to consider on a kite.

Activity

The aim of the activity is for students to design and build kites that soar in the skies, in celebration of the spirit of flight.

Investigate

1. Teachers make samples of the different kites prior to the lesson. These are to be used for children test and fly around with.
2. Students work in groups of two or three to test these kites and learn how they work.

Fly these kites in an open area (e.g. field or auditorium – but not near trees or power lines).

What is the purpose of the tail? Which one is easiest to keep afloat? What happens when we walk or run faster?

These links give instructions to different kite designs:

a) Standard kite: [How to make a Paper Kite [Illustrated] : pics (reddit.com)]

b) Paper plate kite: [How to Make a Paper Plate Kite for Kids | The Country Chic Cottage]

c) Simple diamond kite: [Kite Making Instructions for Kids : How to Make Toy Kites Crafts for Children with DIY Instructions, Patterns, Activities for Children and Teens (artistshelpingchildren.org)]

Generate

The groups select the kite that they want to make. They are to make two versions of the selected kite.

1. Students discuss and decide how the two versions of their kites will differ (i.e. the kites could be made of two different materials for the kite body, with different lengths of tail, two different sizes, etc.).
2. Students gather the materials to make their kites.

Produce

Students build their kites and test their kites in an open area.

There will be a lot of testing in this part of the process to make kites that fly well. With enough kites afloat, especially on a windy day, it will look like a mini-kite festival in the schoolyard!

Evaluate

Students compare the performance of both their kites.

Which material was more suitable and how? What was the purpose of the tail? Why is it required?

For kite enthusiasts in the class, perhaps they could make an improved version of their kites to fly on a windy day.

HOW TO USE THIS ACTIVITY WITH YOUR STUDENTS

Foundation – Year 2

This lesson can be used to highlight the role of kites in Asia. Kites in Asia come in many unique shapes (e.g. the Malaysian wau, the Indonesian layang-layang, Chinese feng-zhengs, Japanese carp kites, and Indian patangs).

Special mention must go to the Vietnamese dieu sao, that have bamboo flutes mounted to them. Kites feature in celebrations, such as Children's Day in Japan and celebrate the start of spring in many provinces in India. Many countries today have large-scale international kite festivals where the biggest and best kites are on display (e.g. Pasir Gudang International Kite Festival, Bali Kite Festival, etc.).

Students could research the shapes and materials of these different traditional kites and compare them to the ones that the students have made. Instructions to make a Japanese carp kite:

[How to Make Japanese Kites: 14 Steps (with Pictures) - wikiHow]

Years 3/4

In science, students in this group are expected to learn about how forces can be exerted by one object on another - either through direct contact or from a distance. Of the forces learnt in this activity, gravity is the only non-contact force. Lift and drag are the result of direct contact of the flowing air on the kite, and tension in the string is brought about by the kite flyer holding onto the kite that is aloft.

From observing and learning from the variety of kites students have seen in class, this group of students could continue exploring how forces work on kites by generating their very own kite design. On a windy day, perhaps a safer version of kite fighting can be organised! Watch the following video to be inspired: https://youtu.be/RdwZMrZxHdc

Years 5/6

In science, students learn about energy transformation and how other forms of energy can be converted to electrical energy. Wind is a vast potential source of renewable energy, and wind turbines use wind energy to make electricity. This occurs through wind turning the propeller-like blades of a turbine around a rotor, which spins a generator, which, in turn, creates electricity. There is an ideal range of wind speeds for these wind turbines to work (generally 20 - 40km/h), as there is an ideal wind speed for kite-flying (between 8 - 20km/h). With simple equipment, such as a protractor, a string, a table tennis ball, and some tape, students could make their own anemometer to know what the wind speed is. Instructions for making the anemometer can be found here:

MetLink - Royal Meteorological Society Make an Anemometer

DISCUSSION SECTION AND KEY THEMES

KEY THEMES

There are several forces to learn about when building a kite.

Forces

Forces possess direction and magnitude (size), and how forces interact determine the state of motion of an object. There are many similarities between forces acting on a plane and those acting on a kite.

In a flying plane, the four forces are lift and weight, drag and thrust. Weight is the downward pull on the plane and lift is the upward push on the plane. Thrust is the forward force in a plane that is generated by its engines, while drag is the opposing force for thrust.

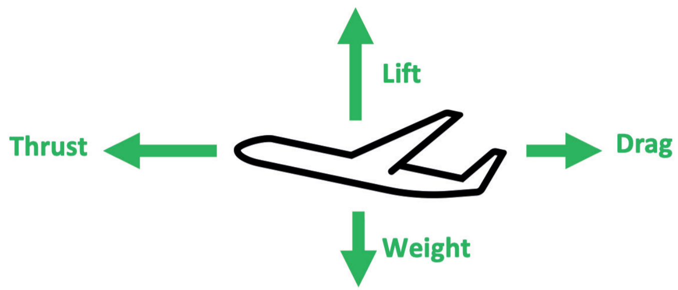

Figure 1. Forces acting on a plane

Without an engine to produce thrust, when flying a kite, it is useful to consider these three main forces acting on the kite: weight, the force generated by the wind (wind force), and tension in the kite line. These are illustrated as the three blue arrows in Figure 2.

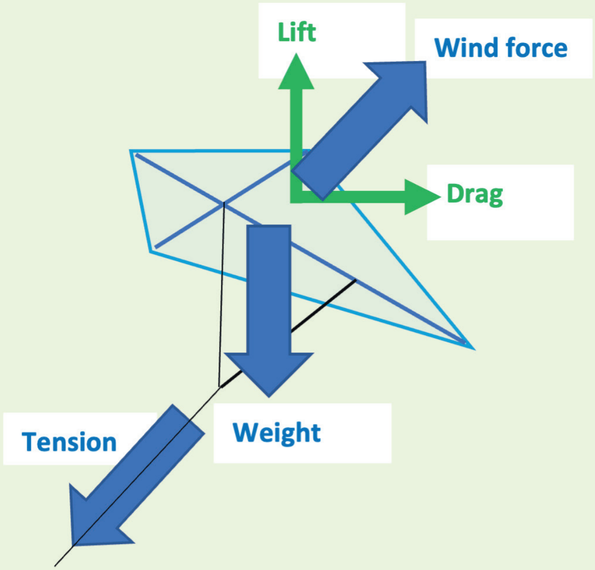

Figure 2. Forces acting on a kite

In a flying kite being held at the end by a person, the tension is produced by the tugging of the person on the string. The wind force is the overall force pulling the kite away from the person.

The wind force can be broken down into two smaller components – lift and drag. The weight acts on the kite's body and pulls the kite towards the centre of Earth.

What is happening when the kite is hovering in the sky steadily?

When these forces are balanced, the kite flies steady. This normally happens when the kite is at its maximum height. At this point, tension is equal to the wind force, and the lift is equal to the weight. The kite doesn't move up or down, forward, or backward, until something changes, such as the wind speed or the line length.

What happens when there is a gust of wind that strikes the kite? Or when the kite flyer runs forward?

When a gust of wind strikes the kite, the wind force increases because both the drag and lift components increase. As the kite is pulled in the direction the wind force, the kite-flyer can feel the increased tension in the kite line. And when lift component of the exceeds the weight, the kite increases in altitude. The same happens as the kite flyer runs forward.

What happens when the wind suddenly stops blowing at the kite?

When this happens, there is no longer any drag or lift on the kite. The wind force is negligible and the tension on the kite disappears. The lift is no longer able to keep the kite afloat in the sky and the kite plummets to the ground under the pull of its own weight.

QUESTIONS AND ANSWERS

But aren't kites boring?

It really depends on whom you ask! Sure, it gets quickly boring and frustrating if one doesn't have the patience to learn the skills to fly a kite. But for those who have, there's kite-fighting! It's exciting and is potentially a dangerous sport. It is played in pockets of many countries but is very popular throughout the Indian subcontinent (e.g. India, Pakistan, and Afghanistan).

It is believed that kite-fighting originated in India, where the aim of the game is to cut an opponent's kite line. It can be played between two competitors or among many opponents.

Competitors coat their lines with something abrasive like crushed glass. The winner is the one whose kite is still in the air when all else have been cut. Variations of the game include 'catching' the opponents kite or knocking off the opponents' kites to the ground.

In Afghanistan, kite runners (usually young children) chase after kites that have been cut to claim as theirs. This game forms the backdrop of the book 'The Kite Runner' by Khaled Hosseini.

Watch a video of the cultural importance of kite flying and kite fighting in India. It showcases how kites are manufactured by hand and simple machines: https://youtu.be/RdwZMrZxHdc

Do Australians fly kites?

Absolutely! Granted that there isn't a strong kite-flying culture in Australia, there are enough enthusiasts to create an annual Festival of the Winds in Sydney (Festival of the Winds 2020).

The inventor of the box kite, Lawrence Hargrave, was an Australian engineer and inventor. He invented the kite design in 1893. He had linked several box kites together, which created enough upward force (lift) to fly him about five metres off the ground! The box kite design was used as weather stations for many years before weather balloons were used.

Why were kites invented?

It is thought that kites were invented in China during time when there was a lot of warring between states (475 – 221BC). Kites may have started off being part of a religious practice but were mainly used for military purposes during this time. They were used to measure distances but became an art form that brought entertainment form signalling equipment in warfare, to being an integral part of science experiments, calculate and record wind readings, and even as a means of communications in the mountainous regions of China.

Are science and maths important to learn how to fly a kite?

Certainly, a person can fly one or two kites very well without any knowledge of the science and mathematics of it. But to express the ideas behind why any kite does certain actions while in flight, predict whether a kite will fly well, build any shaped kite, and find the altitude of kites in flight, science and math skills are very handy to have. Another bonus of science and maths is that they can help us extend these understandings to aircraft and rockets.

How do you fly a kite?

According to the National Kite Month website, kite-flying can be both safe and successful. Start by standing with the back to the wind. Hold the kite up by the bridle and let the line out. If there is sufficient wind, the kite will go up. Let the kite fly away a little, then pull in on the line as the kite points up so it will climb. Repeat this until the kite moves high enough to find good steady wind.

How to fly a kite (nationalkitemonth.org)

Can we only fly kites outdoors?

Wind is necessary for kites to fly but this activity can also be done indoors, as long as we can generate wind by moving fast enough. Wind is what we feel when air around us moves. We need wind to strike at the kite body to create the forces lift and drag so that the kite flies.

Lift is created by differences in the speed of air flying over and under the kite and drag is created by difference in the speed of air between the front and the back of the kite. Kite-flyers can create these forces by moving their bodies and arms.

Can kites be powerful enough to pull people?

They sure can! Although traditional kites were not intended as a mode of transportation, newer designs have been invented to maximise the power and pull - on land, water, ice and even snow! These kites are referred to as power kites by the American Kitefliers Association. These kites can be used pull buggies, snowboards, kite surfboards. Multi Line Kites by Purpose | AKA American Kitefliers Association

Can kites have more than one kite line or more than one kite body?

Traditional kites have one kite line and one kite body, but newer designs (referred to as stunt or sport kites) that are showcased at international kite festivals come in all sorts of combinations. There are very large kites with multiple moving parts (some with over 200 smaller units!), which require several kite pilots to manoeuvrer. Sometimes, a kite pilot may fly a few kites simultaneously.

What is a kite in Maths?

In maths, a kite is a flat shape with four straight sides.... and it looks like a typical kite. It is symmetrical and can be divided into two identical triangles, joined base-to-base. It has two opposite and equal angles.

What about the other kite?

Kites are also birds of prey, which can be found in warmer regions the world over. Typically, kites have small heads, short beaks, long narrow wings and tails. The Whistling Kite, Black Kite, Brahminy Kite, and the Black-breasted Kite can be found in Australia. Each species hunts different prey, largely depending on where they live, fish, small mammals, insects, lizards, and even emu eggs!) Black-breasted Kites have been observed to drop rocks on emu eggs from the air to break the thick shells.

OUTSIDE OR SUPPLEMENTARY READING

History of kites

- Kite History (nationalkitemonth.org)
- History of Kites | AKA American Kitefliers Association
- How kite is made - material, manufacture, making, history, used, parts, components, industry, machine, History (madehow.com)

Forces on a kite

- Make a Kite With Physics - Science Friday
- Forces on a Kite (nasa.gov)

TOPIC WORDS

- Forces
- Kite
- Weight
- Lift
- Tension
- Drag
- Wind force
- Balance
- Kite-fighting

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