

Transcript BLOSSOMS Soaring In the Wind: The Science of Kite Flying

Aisha

Greetings! Hello! I'm Aisha. Have you ever flown a kite? It can fly really high and soars in the wind. Today, we will learn about the science and engineering of flying kites. The objective of the lesson are to identify and know which forces make kites fly stably and relate them to the anatomy of the kite. In Malaysia, where I come from, every state has its own special kite. Malaysia has fourteen states and our kite called 'wau' have special names given to them. Let's watch this video clip about Upin and Ipin, a popular Malaysian cartoon, at a kite festival in their village.

Mail

Two kites for RM 1..

Upin & Ipin

Waaaaah!! So many Wau! All kinds of colour.

Upin

Grandpa..why all the wau's are different?

Grandpa

Of course it's different. Even wau has many types. Look at that one, Wau Kucing. That one over there is Wau Kapal.

Ipin

Grandpa, what about that one?

Grandpa

Ahaa..and that one is plain and simple shape of wau. No shape and design at all! It should not enter this contest.

Adult 1

Eeehhhh..why they say I'm such a slacker...

Grandpa

But..this one, the most beautiful wau of all. This is the proudest wau of Malaysia., Wau Bulan. Now, come and help me.

Upin & Ipin

Yeaay!...

Grandpa

Hold it steady!

Upin
Alright grandpa.

Ipin
Quick grandpa, quick!

Grandpa
Ready?

Upin & Ipin
One, two, fly...Waaahh!

Upin
Our wau looks beautiful. We sure know how to fly a wau right Ipin?

Ipin
Clever, clever. clever.

Grandpa
You guys want to play?

Upin & Ipin
Yeaay!...

Aisha
Those were some of our wau, wau kucing, wau kapal, wau merak and wau bulan. Did you see how they fly the kite? There is a lot of science and engineering involved in making and flying kites. Anyway, we will discuss this in detail in the later segments. For now, we will look at the anatomy of the kite. Break into groups of three or four and discuss the following: What is a kite? Can you sketch and label the parts, as well? You can share your kite flying experiences, if you have any. I will see you in a little while.

Aisha
Hello again. Did you manage to describe, sketch and label your kite? Watch the following clip carefully, you can compare your answers there.

Upin
So many bamboo..what do you want to do with it grandpa?

Grandpa
To create a wau..

Ipin
Wau?

Grandpa
Yes..A wau. The big kite!

Upin
A kite?

Ipin
Big?

Upin & Ipin
Can we try grandpa?

Upin
But, we do not know how to make a kite grandpa.

Grandpa
This is the problem of children nowadays, they know nothing about making a kite. Haa..come, I'll show you how.

Ehsan
Upin, Ipin..we patiently waiting long enough, you know! You said, you want to play?

Fizi
Hmm..what are you guys doing?

Ehsan
Not invited us too!

Ipin
We want to make a big kite!

Ehsan, Fizi, Meimei, Mail
Haaa..whoaaa!..

Ehsan
Can we make a kite too?

Meimei
I like, I like..

Grandpa
Uhh..no..my wau will not be completed if like this. Be careful.

Meimei
Grandpa, how many bamboo stick are needed?

Grandpa
Take 2 piece of bamboo stick.

Ehsan
Hurry up grandpa! How do I do this?

Grandpa

Haa..like this. You tie here, and also here..after that, cut this part, and paste it!
Haa..it's done!

Ehsan, Upin & Ipin

Haaa?..

Ehsan

Grandpa, please taught us properly..

Grandpa

Okay, one more time. The first step is, cut the thread. Then, tie on this bamboo.

Meimei

Grandpa. I'm done!

Ehsan

Haaah? You done already?

Meimei

Is this correct grandpa?

Grandpa

Good job Meimei! That is how to do it.

Meimei

Thank you grandpa!..

Upin

Aitt..why is my kite not even the same? Is a kite small or big?

Grandpa

A kite is small in size, but the big one is called Wau!

Fizi, Ehsan, Upin

Oohh..

Grandpa

Ipin..where is your kite?

Ipin

Not ready yet.

Grandpa

Mail, how about your kite? So many kite! What you gonna do with all that kite?

Mail

I want to sell it grandpa, so I can make some money.

Grandpa

My goodness, I got nothing left for this bamboo. Meimei, bring your kite to me. Let me tie a string on the kite.

Meimei

Give me a moment! Here..

Grandpa

Oohh..that's nice! All of you look here ok?

Ehsan, Fizi, Meimei, Mail

Ok grandpa.

Grandpa

Tie properly, so it's easy to fly then. Understand? Aha..like this.

Fizi

Like this yes grandpa? Right?

Meimei

How did you tie the string?

Grandpa

It cannot fly if you tie it wrong. Let me repair it for you.

Aisha

There you are, we now know a little bit more about the parts of kite and its anatomy. I'm sure you can try to make your own kites. But bear in mind that what you have seen from the video earlier is an example of diamond-shaped single-line kites with two-point bridles. A particular kite might have only one bridle line connected to the flying while other types of kites may have two, three, four or maybe even more pairs of bridle line, depending upon the size of the kite and what a particular type of kite is designed to do. For example, look at some of these examples.

Aisha

Hmmm, I wonder..how to get kites up in the air and what keeps them flying? Do different types of kites have different flying capabilities? How does size and weight affect the ability of a kite to fly? All these questions and more, comes to mind as we look up at the array of kites that fill a sky at a large festival.

Aisha

To answer some of these questions, let me demonstrate a simple experiment through the next activity. I will use two different densities of cardboard. See what happens to the cardboards when I switch on the fan. Now, you will do one simple experiment in your group. The experiment will look at the effects of weight and lift. I will see you after you're done.

Aisha

Hi..the experiment was to show you the effect of forces such as lift and weight acting on the cardboards. In the experiment, the cardboards stays in the air due to the force called lift. Your two hands holding on both left and right side of the top edge of the cardboards provide an opposite and equal force that prevents them from flying off. Also you would have seen that the lighter piece rises slightly faster than the heavier piece. Why is it so? This shows that it need less lift. How do these forces work on kites? There are also other forces acting on the kite. Let's watch Upin and Ipin again.

Upin

1, 2, fly..alaaaa..

Ehsan

Quick Fizi quick! I can't wait much longer! Get ready!

Fizi

Ishh..why do you always be the first!

Ehsan

1, 2, Yeaaa...

Fizi

Ehsan, wait up! Ehsan!..

Ipin

How exciting!

Upin

I'm tired! Why it doesn't go up?

Meimei

My kite is flying, my kite is flying!

Ehsan, Upin & Ipin

Waah..

Upin & Ipin

That's awesome Meimei.

Meimei

Please don't, please don't!

Ehsan, Upin & Ipin

Haaaah...Meimei's kite gas falling down.

Aisha

There are four forces acting on the kite. And they are the lift, weight, thrust and drag. The lift is the force that stops a kite from falling down. Lift as caused by streamline curvature pushes the kite up into the air. Streamline are a family of curve that are instantaneously tangent to the velocity vector of the flow. When streamlines are curved, pressure drops as a pressureprobe moves toward the upper surface. It has to be that way because air like any other thing moves in a straight line cannot curve unless acted on by forces. Since a kite at a positive angle of attack, causes the streamline to curve. The pressure must be dropping as it move from far away toward the top surface. Therefore, the top surface is at a low pressure. The same idea applies to the bottom surface in the other way. The pressure must be rising as a kite move from far away towards the bottom surface. The bottom is surface is at a high pressure. The pressure difference between the bottom and the top gives rise to lift. As stated in Bernoulli's Principles that when air speed increases the air pressure decreases. Daniel Bernoulli was a scientist in the eighteenth century.

Voice-over (Jeffri)

You can experience this phenomena when you put your hands outside the window of a moving car and positioned it at different angle. Take a look at this video. Discuss with your teacher and friends, what just happened during the phenomena of lift.

Aisha

Now let's learn about other type of force which is weight by watching the next video.

Meimei

Please don't, please don't!

Ehsan, Upin & Ipin

Haaaah...Meimei's kite gas falling down.

Meimei

Haiyaa..there's no wind. How do we want to play kite if there are no wind?

Aisha

As you can see in the video, the kite fell down! Why do you think this happened? The second force is the weight of the kite acting downwards. It is due to the pull of gravity on the kite. Gravity pulls everything towards the centre of the earth, so kites in the air can get pulled down to ground level. That is why many kites are usually made from lightweight materials. The heavier kite requires a higher wind velocity to fly. Once you have a strong steady wind, it is not really hard for someone to fly any type and size of kite.

Jeff

Well, thank you Aisha. Hi, I'm Jeff. I will assist Aisha on the explanation about the forces. Now, let's extend our experiment. We will use different materials, some with tails, some without. We will also try different wind speed. How will these

differences affect the movement of your strips? Discuss your observations with your group members and try to relate to kites. What type of material would you use to make your kite fly higher and why? Does more wind help? What is the effect of having a tail? Have fun and Aisha will see you in a while.

Aisha

Hi again, did you enjoy that? The experiment was to show you the effect of the wind speed and to show you a little bit about the effect of drag. Since we also use different materials, we saw that weight also has an effect on the lift. Did you see that a lighter material and a fast air speed make the miniature kite fly at a flatter pitch angle? The higher air speed created a bigger pressure difference resulting in a bigger lift thus the miniature kite fly at a flatter pitch angle, as how real kite fly higher outdoor. What about the tail? What is the effect of having a tail? We will discuss the answer next but before that, let's watch this video.

Ehsan

So, you want to challenge me huh?

Fizi

Just you wait.

Ehsan

Ishhh..it cannot be! You can't defeat me!

Fizi

How high is your kite!

Upin

Eh, Ehsan..where's your kite string? So your kite does not use a string huh?

Ehsan

My kite!!..

Voice-over (Jeffri)

From the video, did you see how they pull on the string and the kites flew higher? This is due to thrust. Thrust is the force that moves the kite forward. Anyway, what is thrust? Thrust is the component of tension parallel to the wind which is horizontal only when the wind is horizontal. Tension is the force that occurs as they pull on the string. The string provides the tension which gives us the thrust. Birds flap their wings to produce thrust and sometimes even to produce lift. While an aeroplane uses an engine to provide thrust. A kite doesn't ordinarily produce its own thrust. When we fly kites we use a string to hold it and to prevent it from being blown away by the wind. The fourth and final force is drag. As the air flows over the surfaces of a kite the wind gets held back a little bit by the roughness of the fabric and the sticks. Nevertheless, having a perfectly smooth kite does not guarantee zero drag as there are many other forces that can cause drag such as the shape of the kite. Now we are getting to the tail. By having a tail, we can create an additional drag (and importantly, a drag that is located aft) This will allow us to make the kite point in the correct direction and

gives a kite stability. If a kite has too little tail it will not be stable and will move around a lot, and might even start spinning around the axis of the string. If the kite has too much tail, the kite will not be stable, but may be hard to keep flying because of the extra weight caused by the excess tail. The same forces act upon kites of any shape, even our wau. Although wau has no tail, but the curved rear part acts as a tail and the fringes at the side adds more drag. Let's watch this video to see what I mean.

Aisha

So to fly, a kite needs the lift, weight, thrust from the tension in the string and drag to be balanced.

Voice-over (Jeffri)

Hi..it's me again. I will assist Aisha to recap what we have learnt about kites. You need the forces to be in balance when the kite flies. All the forces reach equilibrium or balance when the kite rises to its maximum height. At this maximum height the lift and drag forces exactly balance out the tension and weight forces. With no resulting force on the kite, it moves neither up nor down until the wind speed or the length of string changes. Kites have many uses scientific, military, as well as for recreational purposes. The military uses kite in target practice. Kites were fitted with rudders and drag from one side to another to simulate a moving object such as a running person. And for recreational activities, we have kite surfing and kite boarding as well as kite competitions for kites of various types and shapes. A major research and development project called Makani Power based in California is investigating the use of kites in harnessing high altitude wind currents to generate electricity. How exciting! But we have come to the end of our lesson. And I hope you have enjoyed them. You saw how easy it was to make a simple kite. So, I hope you will try and make your own kite. Go out, fly your kite, and enjoy the experience. If you want to know more about Malaysian wau, have a look at these link below:
Goodbye...and have a great day.

Aisha

The video is about the science of kite flying and the setting is in Malaysia. The video can be used as an extension of a physics lesson especially after the students have learned about forces. It will focus on some of the concepts such as weight, thrust, lift and drag. Some principle such as Bernoulli's Principle and Newton's Law is now framed within the context of flying kites. With this video, students are encouraged to think about kite flying in terms of the scientific concepts of flight while discovering and enjoying the world of kite flying which is shared throughout many parts of the world. As an added value, this video will also share some information about Malaysian kites which are 'tailless'. The Malaysian kite is called 'Wau' and there are many distinctive designs and each Malaysian state has its own official Wau. Malaysia has fourteen states. You might want to draw their attention to the shapes of the typical kite and the Wau. What features are the same and how they are different? The objective is to draw students attention to the fact that kites are designed based on scientific principles related to theories of flight. The lessons provided are to be conducted in class and students are to work on the question given in the lesson in small

groups. Students are to carry out two simple experiment to study how air flows on a kite. There are many types of kites such as the diamond and delta kites, bowed, cellular and multilined kites, figure kites like our wau and soft kites. For more information please refer to the website www.kite.org. If time permits, you want to take your student for kite flying activity outdoor. If not, just refer to the activities that we have suggested. If your students are not familiar with kites, you could use other analogies such as paper airplane or paragliding but you will have to explain to your students the distinct differences of forces involve in every analogy you gives. Thank you for viewing this video.