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**

Waaaahh!! 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 peace. 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 draf that is located aft) This will allows 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 ne 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 c=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.