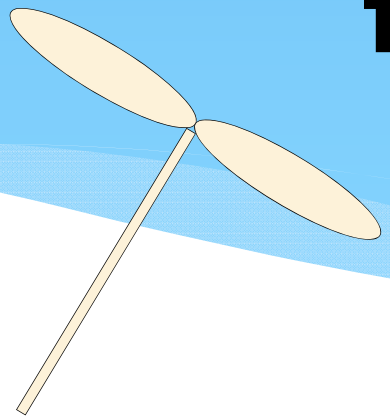
Lesson plan for space education based on the approach of "Kasetsu Jikken Jugyo" -Hypothesis-experiment-lesson-.

Flying Around the Sky

Using a "Platombo"- Plastic Propeller Stick -

SEEC 2016



Tomohiko Aikawa

Teacher at Takamine Junior High School, Itoman City
Okinawa, Japan


JAPAN
←OKINAWA
US Dept of State Geographer
© 2015 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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画像取得日：2013/4/10　31° 41'45.02" N 133° 15'11.04"

Ryukyu Dancing

Shuri Castle

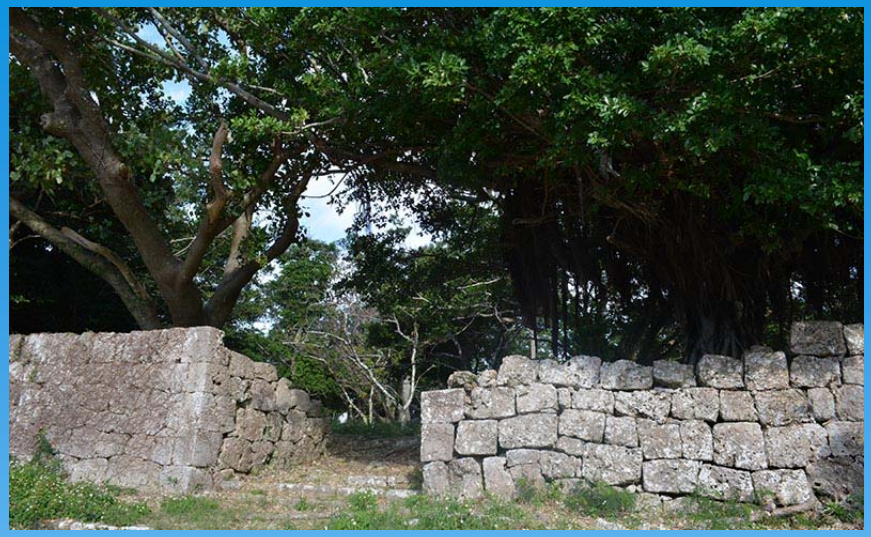
Takamine Junior High School, Itoman City

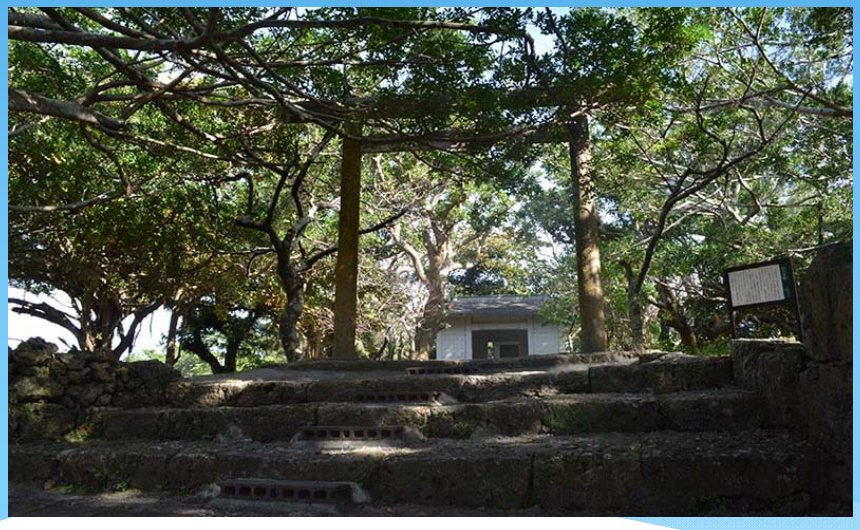
School crest

School building

School motto:

Fresh spirit, Refinement of knowledge, Steadfast aims

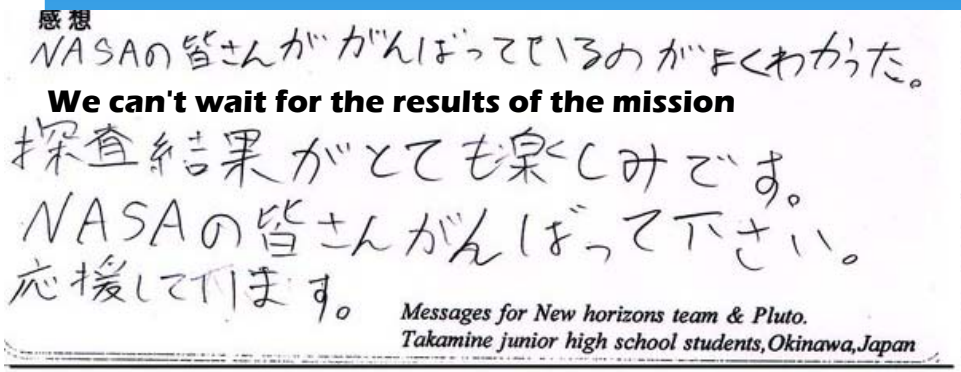


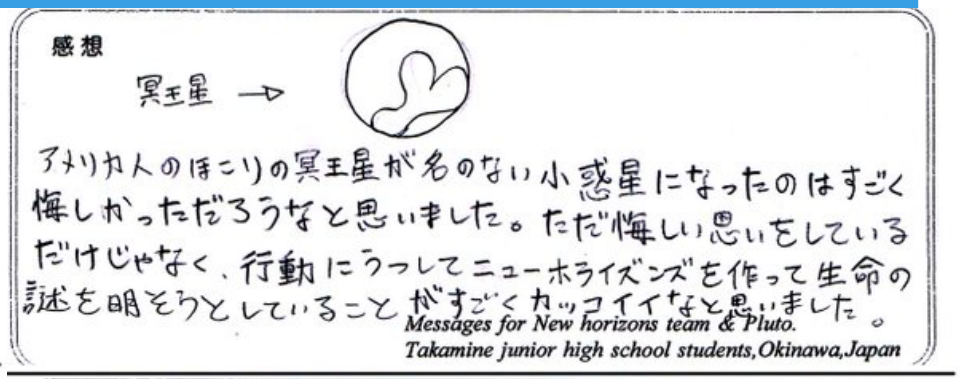


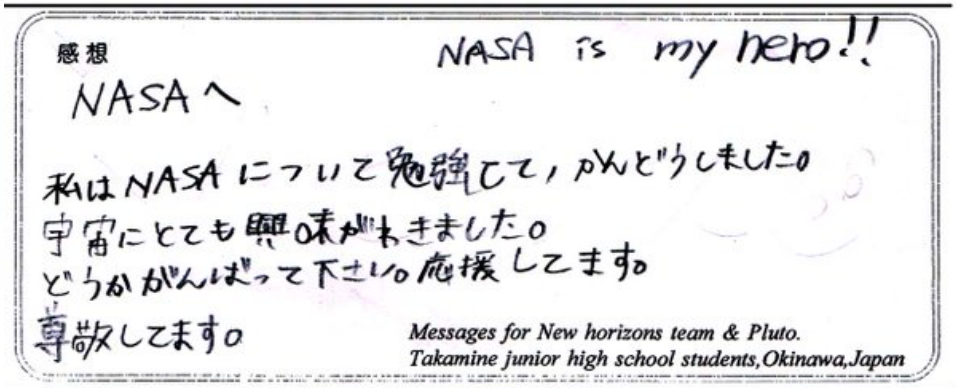
Nanzan castle ruins

Maezato tug of war

Message of support for New Horizons from the students of Takamine Junior High School







The students love space!

Photos from Wikipedia

Bamboo forests in Japan

Bamboo dragonfly (Taketombo)

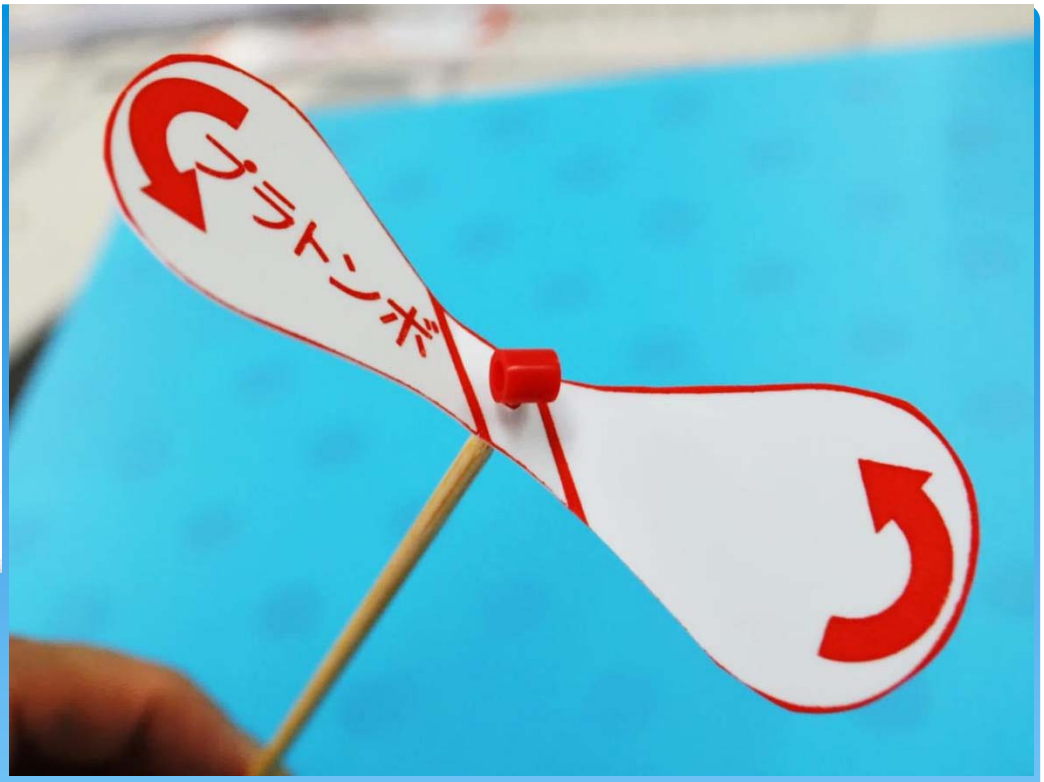
Photos from Wikipedia

Bamboo=« Take »

Dragonfly=« Tombo »

Photos from Wikipedia

Bamboo dragonfly (Taketombo)



Plastic Propeller Stick

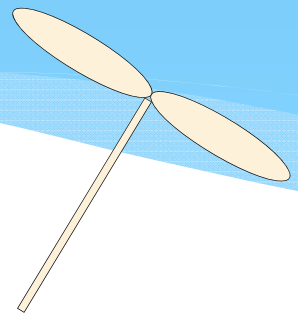
“Platombo”

Conceived by: Masaki Ando (Associate Professor at Shokei Gakuin University) and Noriaki Abe (elementary school teacher in Miyagi prefecture) *1

Lesson plan for space education based on the approach of "Kasetsu Jikken Jugyo"*2
-Hypothesis-experiment-lesson-.

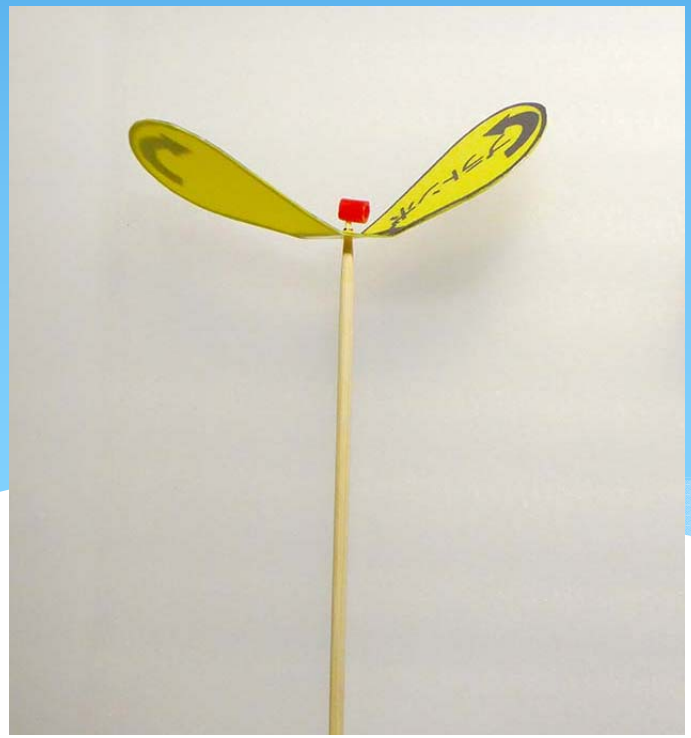
Flying Around the Sky *3

Using a "Platombo"- Plastic Propeller Stick -

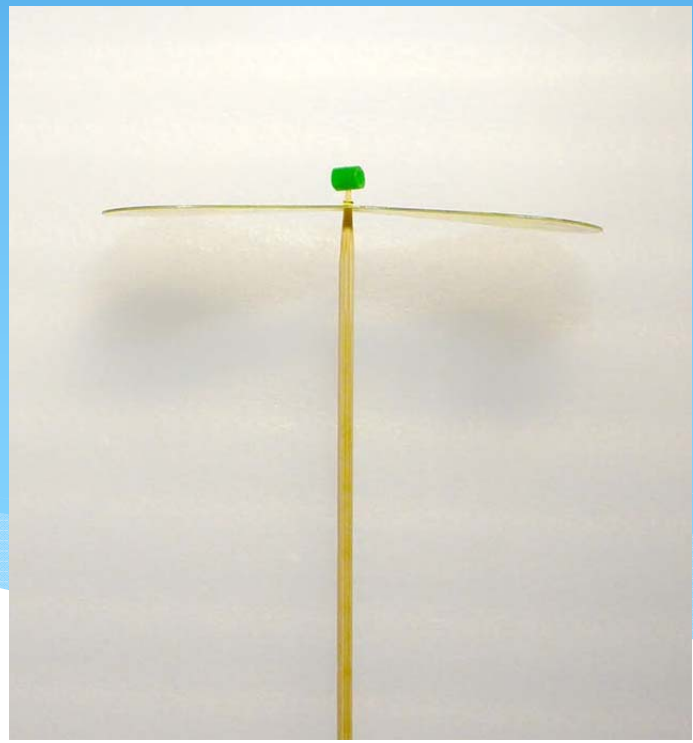


Question 1
What's the difference?

A



B

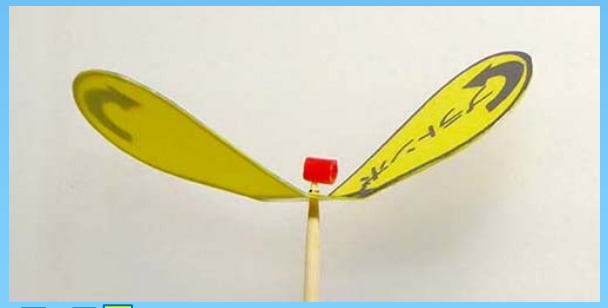


Question 1

What's the difference?

A

Flies

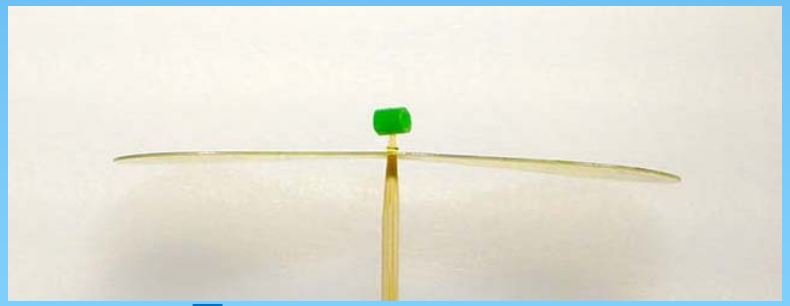


Wings are

angled

B

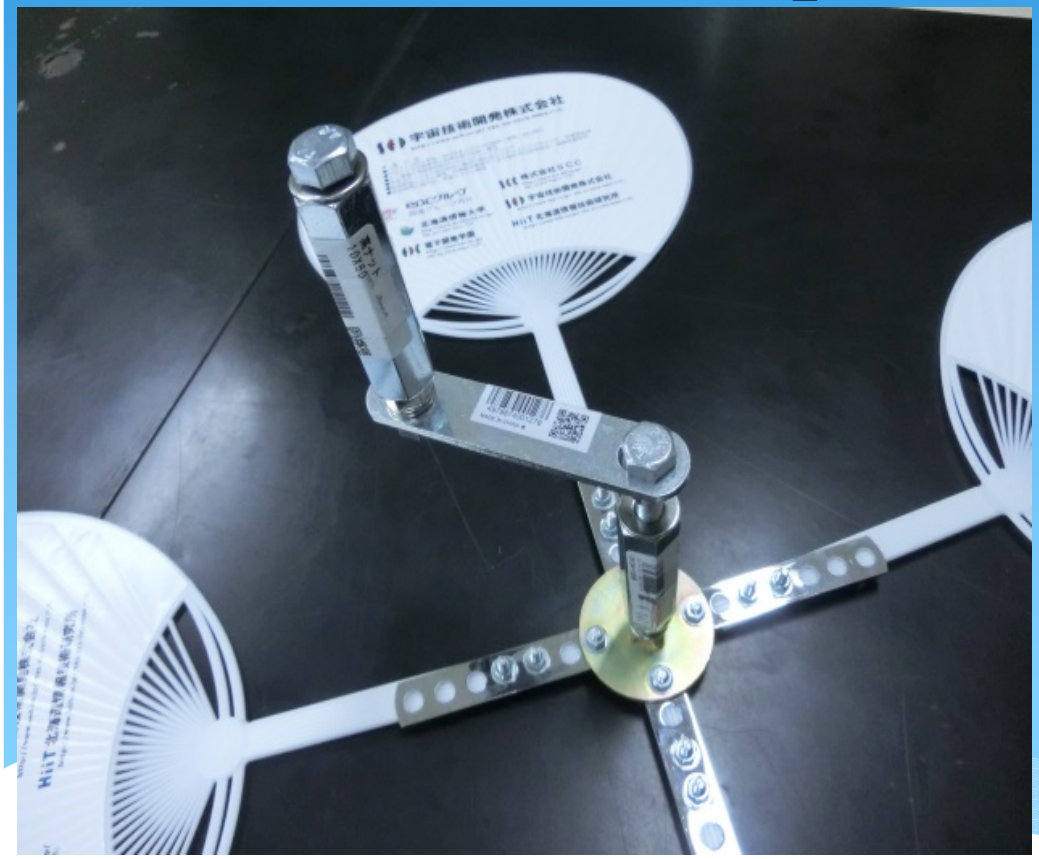
Doesn't fly

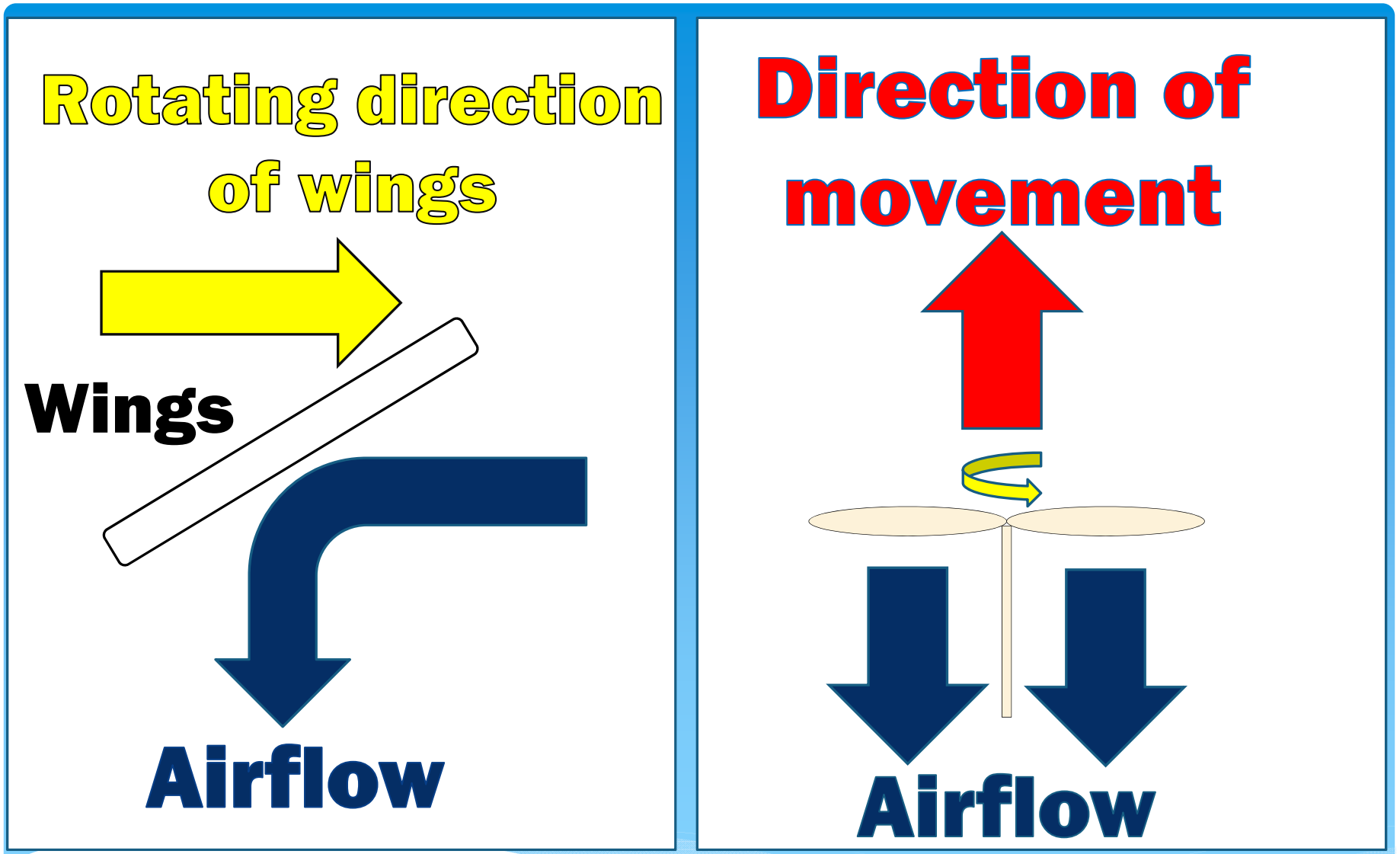


Wings are

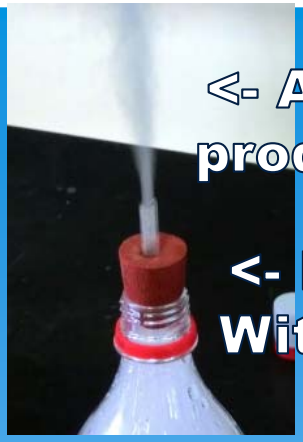
straight

Explanation using fans (Uchiwa)



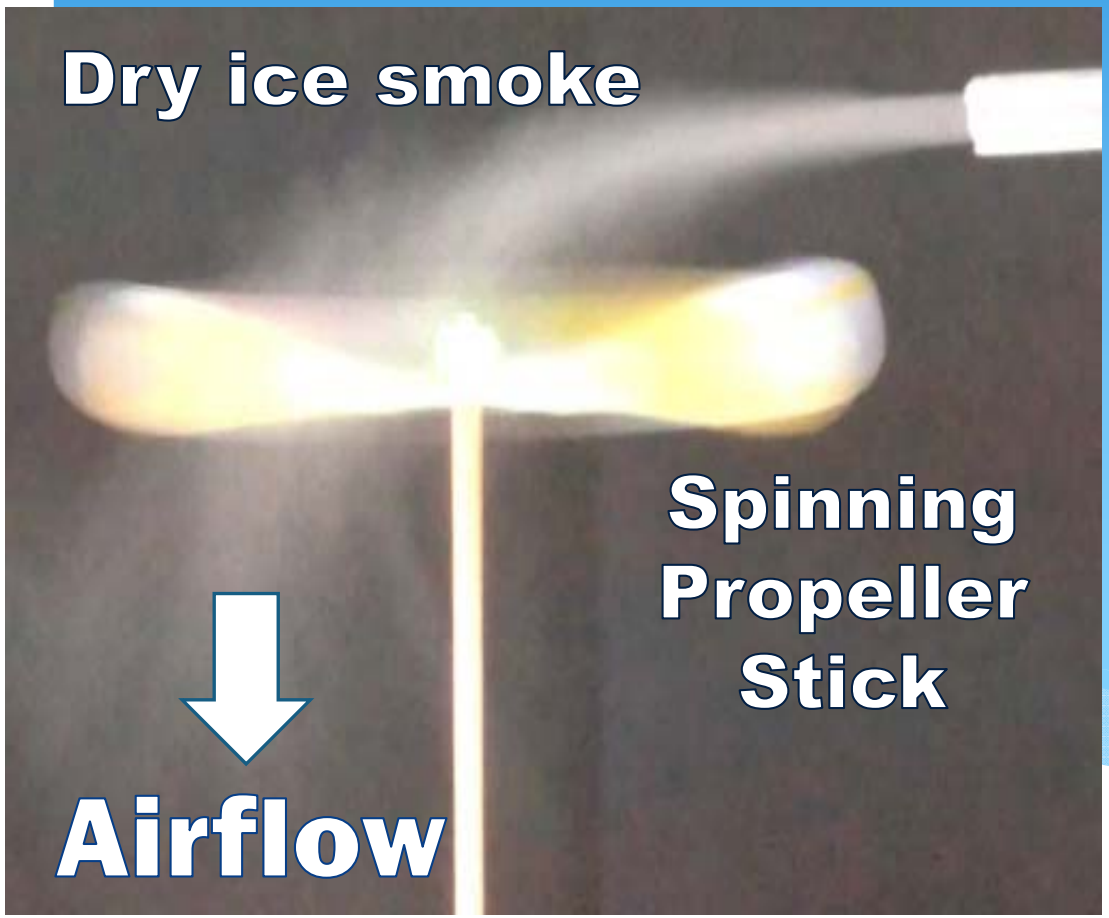


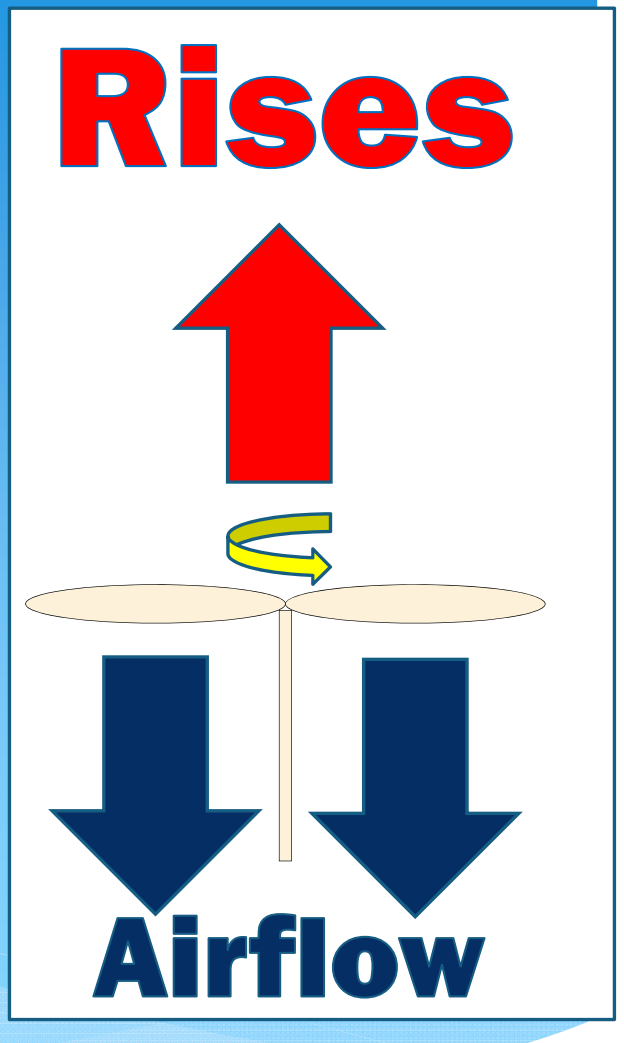
Moves (flies) in the opposite direction to the airflow



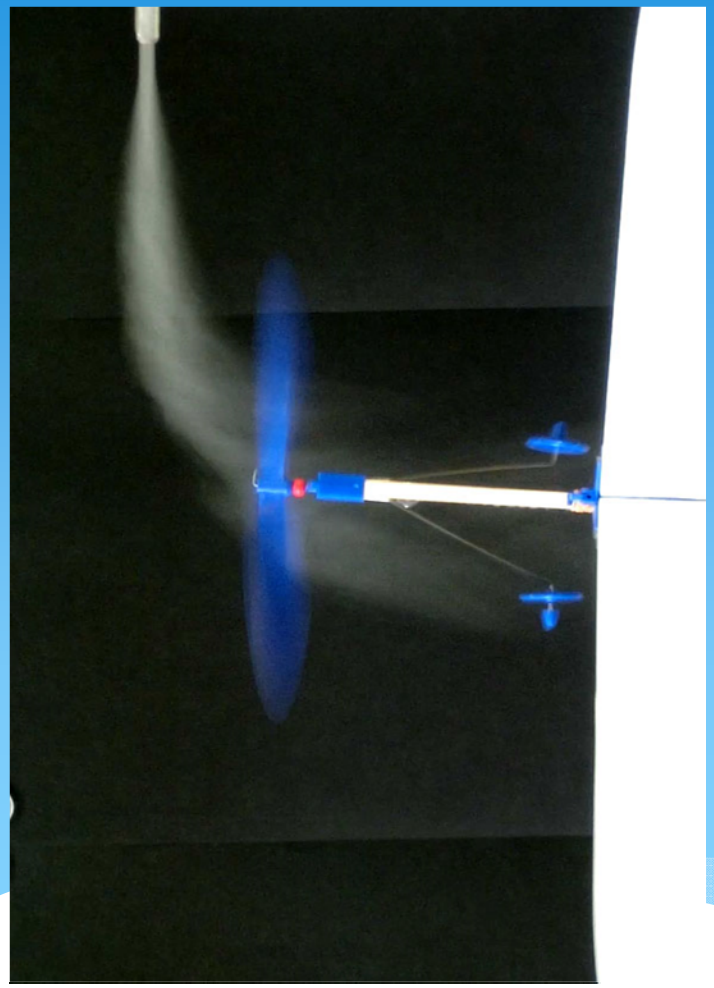
<- Adding water produces smoke

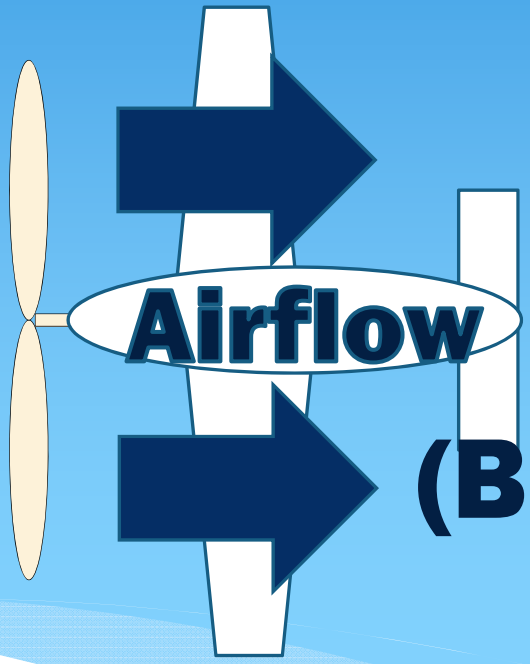
<- Rubber cork With glass pipe





Airplane model





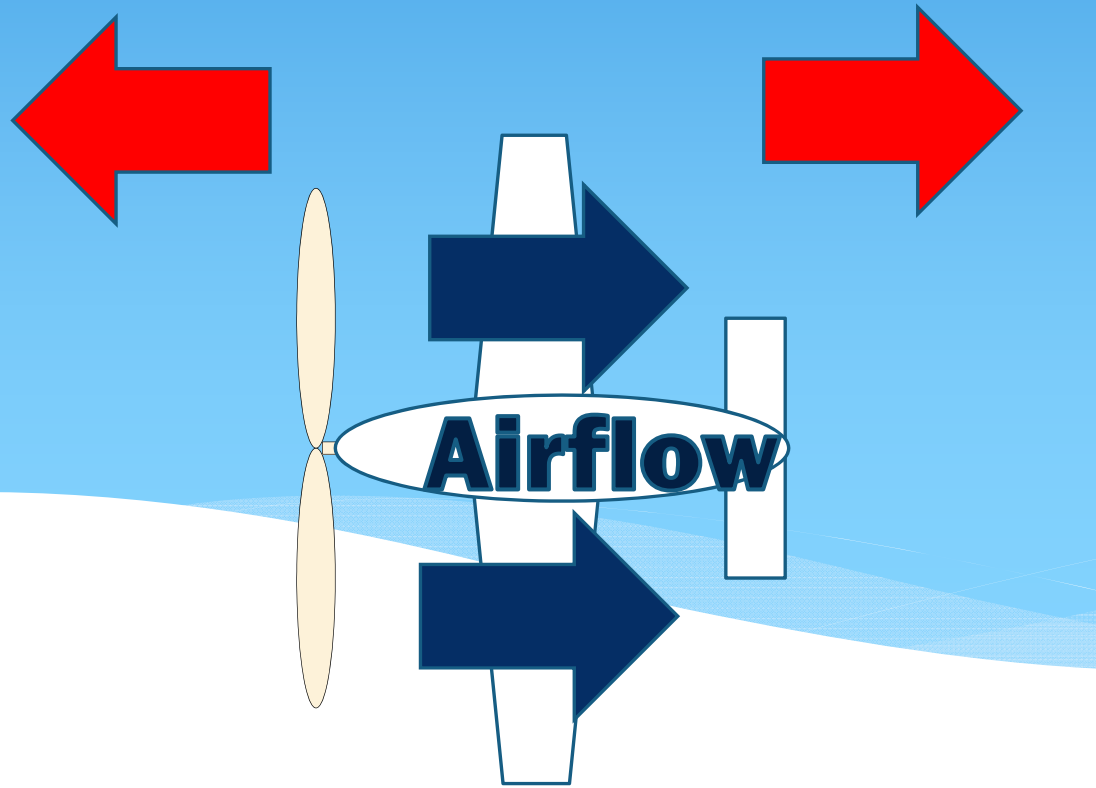
(Backward)

Question 2

Which way will this airplane go?

Forward?

Backward?



Question 2

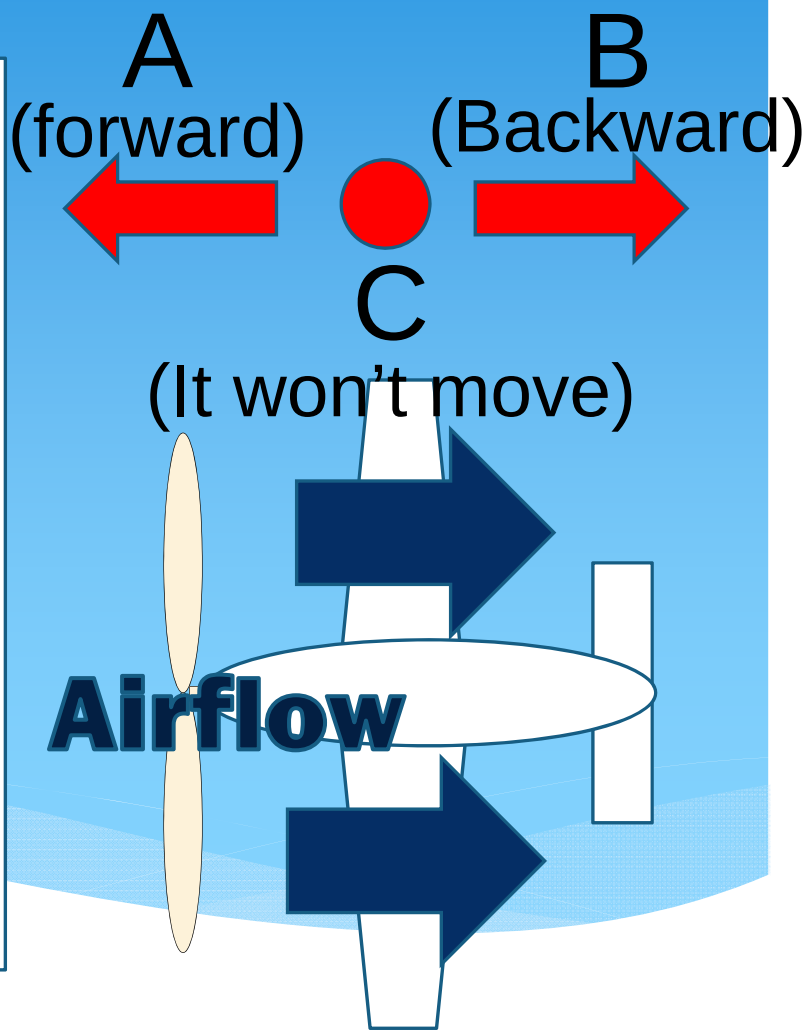
Which way will this airplane go?

Prediction

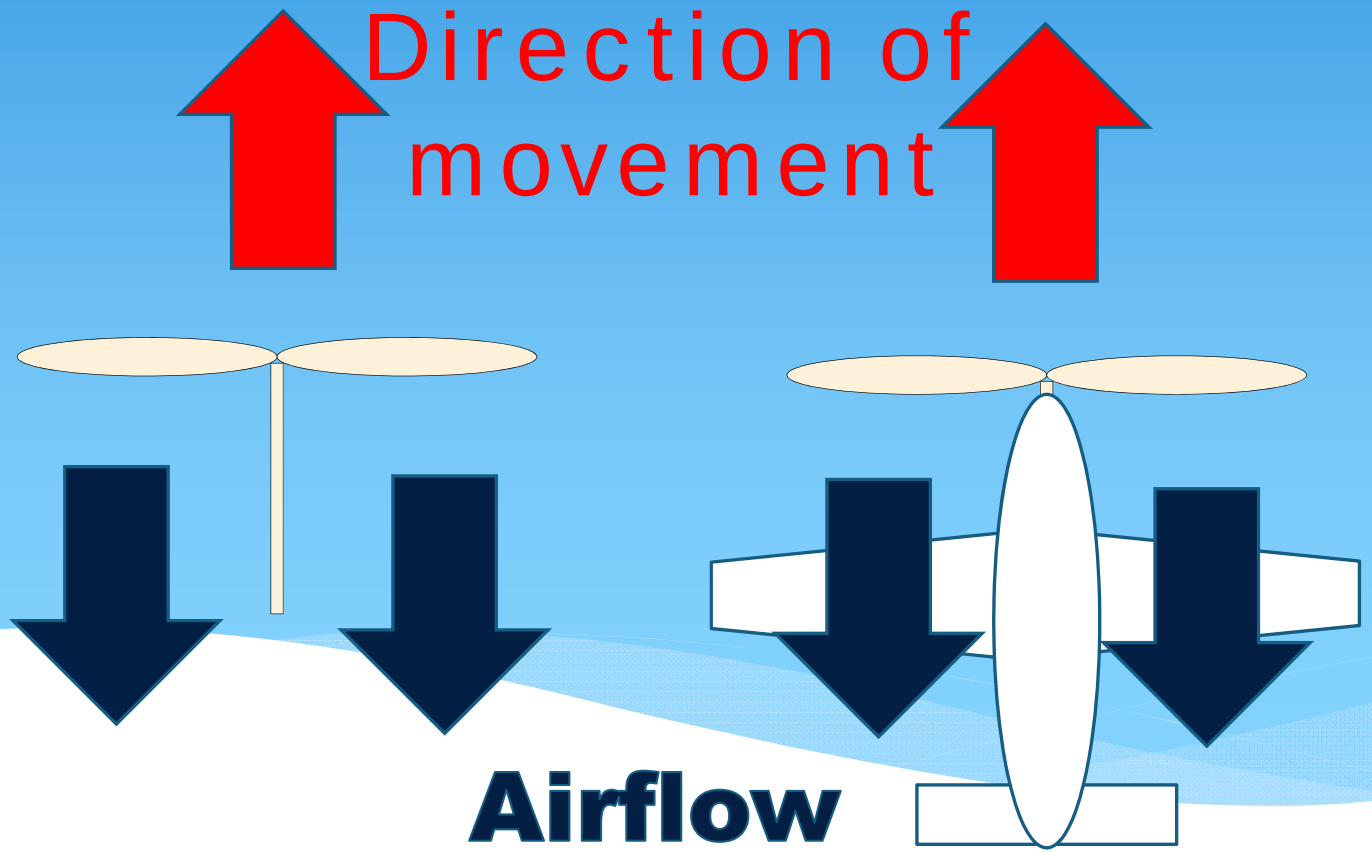
A. It will move forward

B. It will move backward

C. It won't move



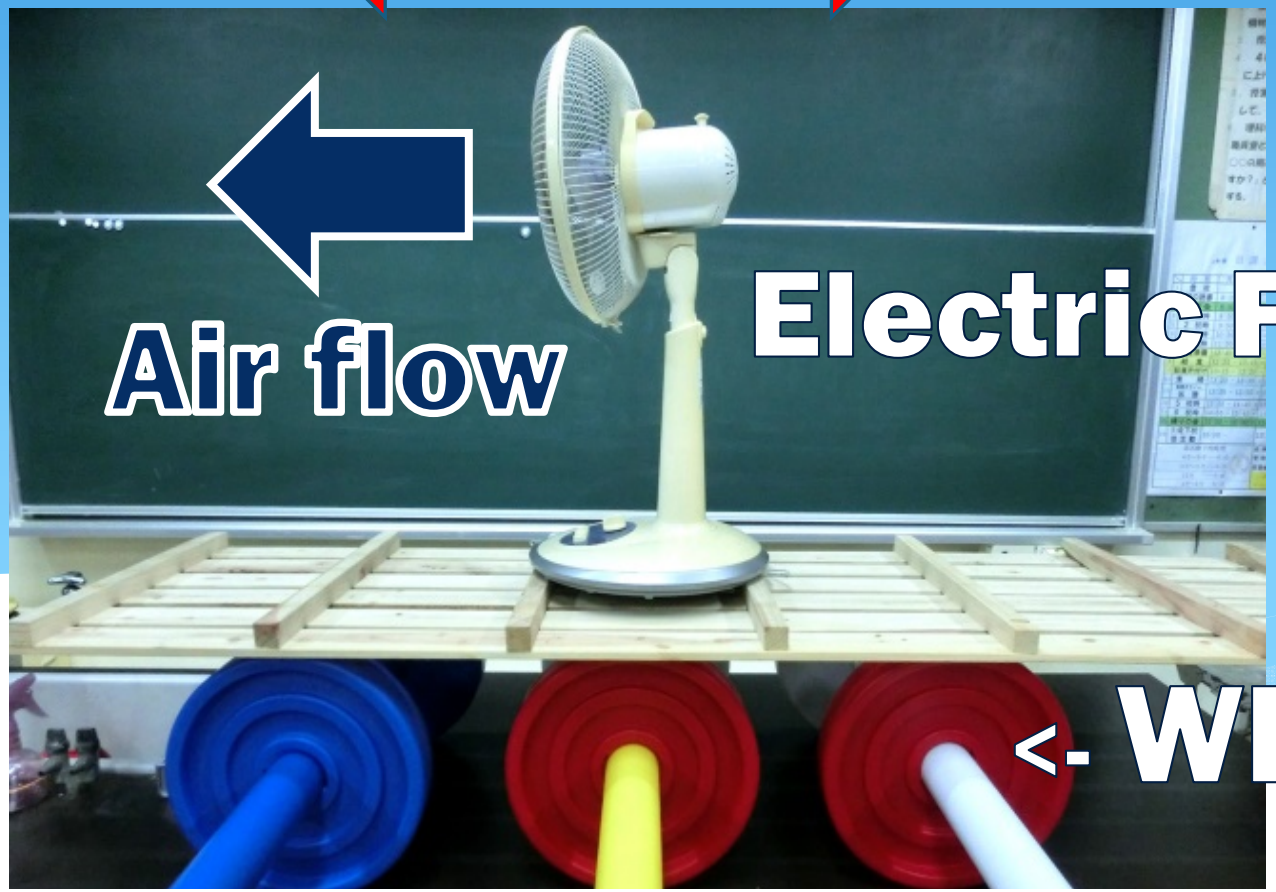
Airplane propellers are the same as the Propeller Stick



Question 3

Will an electric fan move?

Forward? ⬅ ➡ **Backward?**



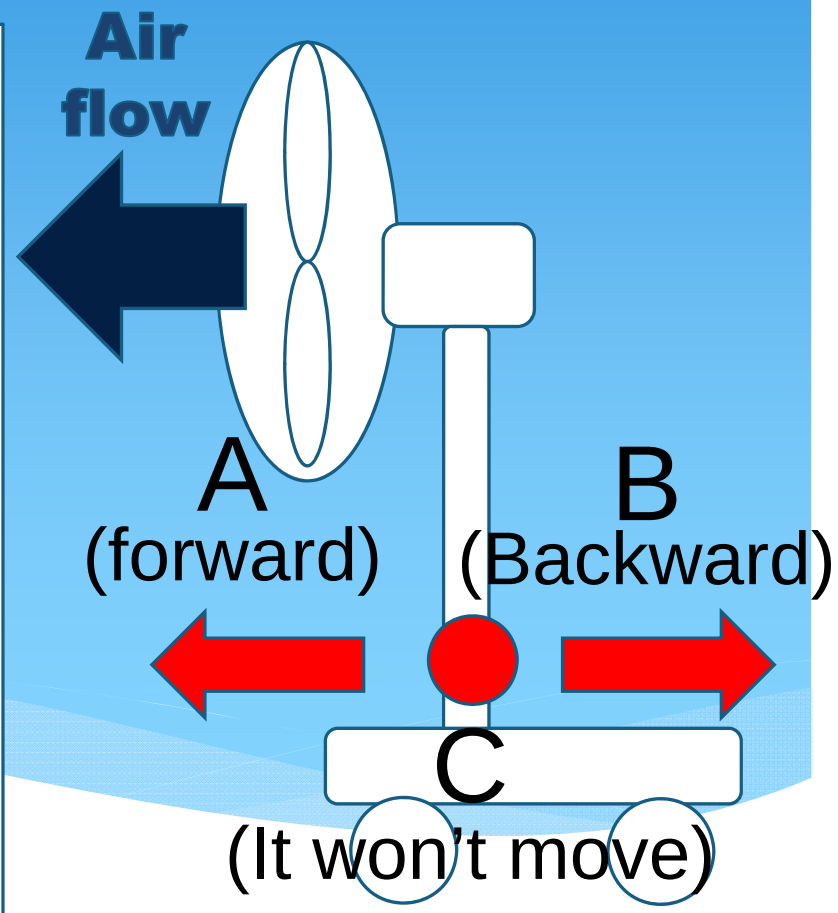
Question 3
Will an electric fan move?

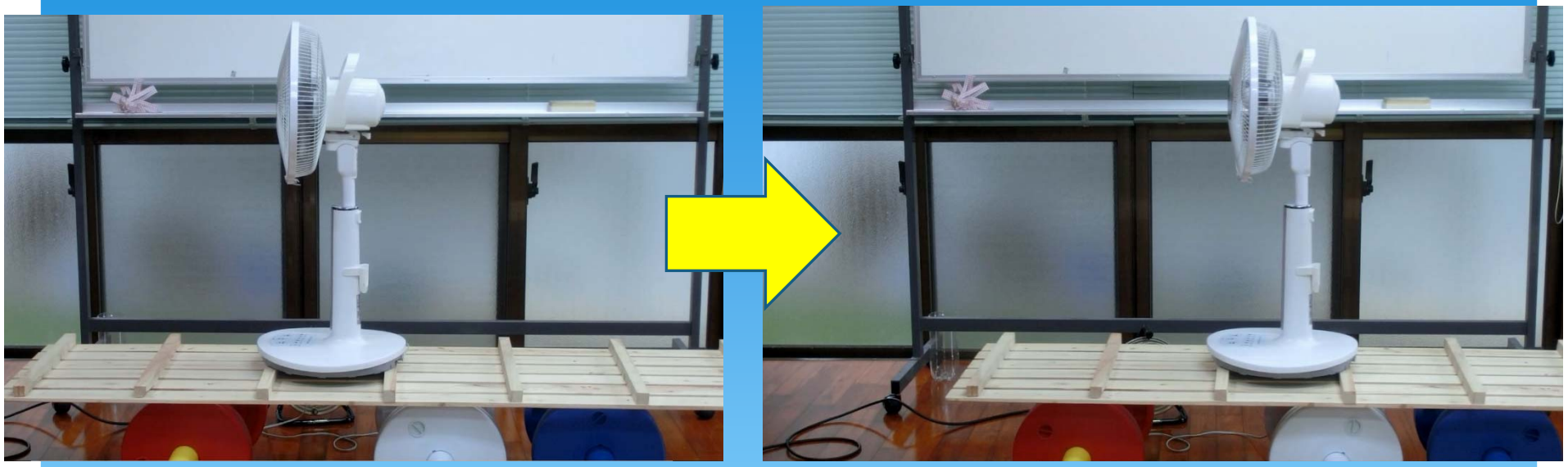
Prediction

A. It will move forward

B. It will move backward

C. It won't move



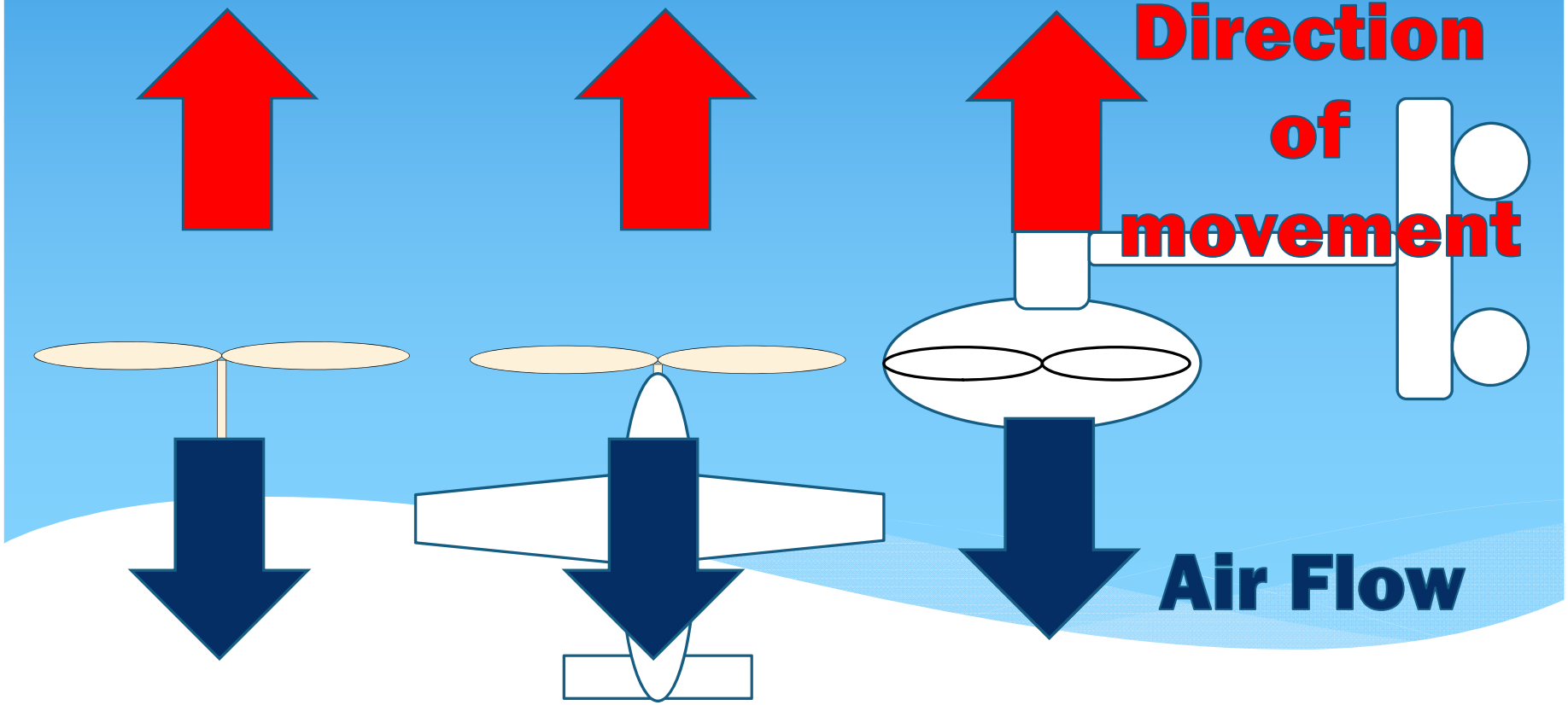


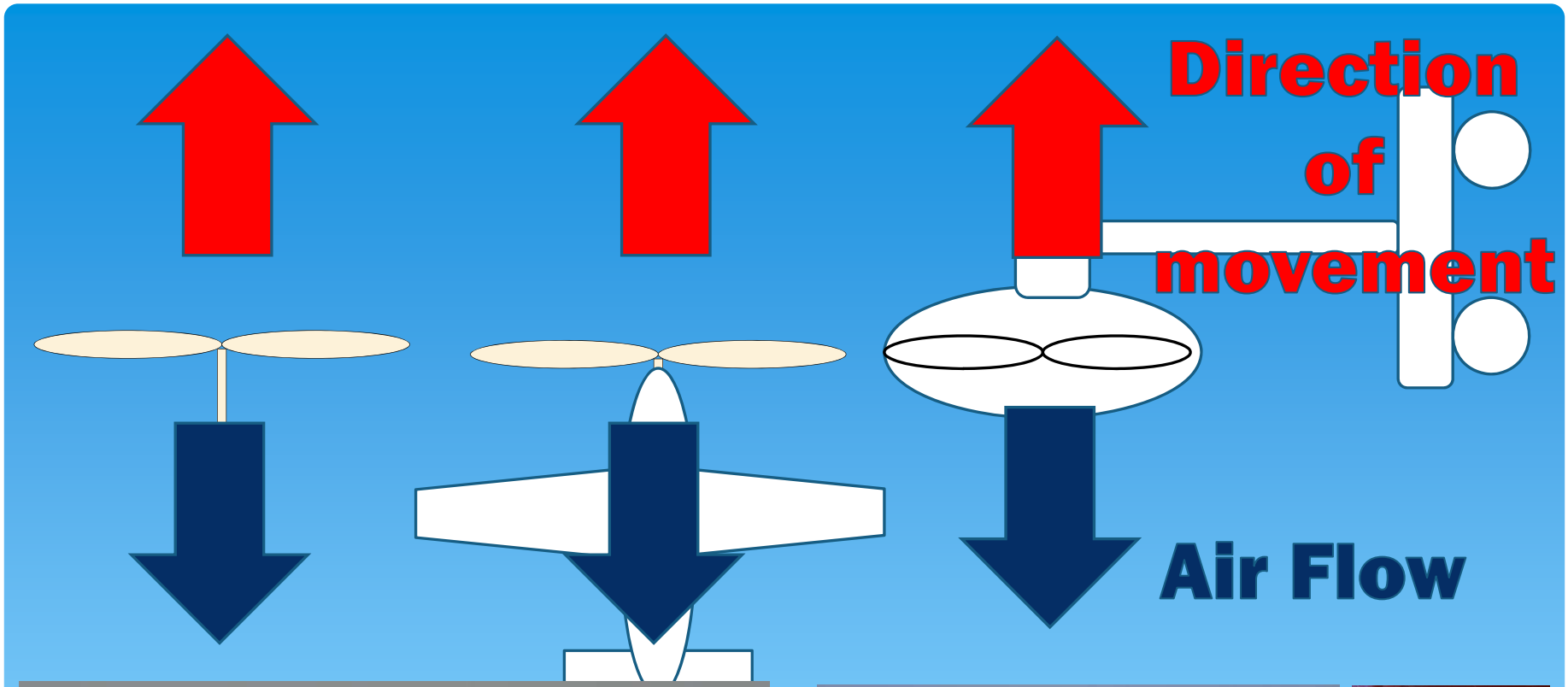
Result: B

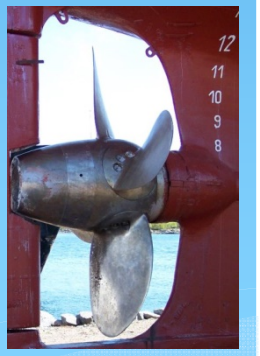
It moved backward.

Hypothesis

It will move in the opposite direction to the airflow







Photos from Wikipedia

The fundamental principle of airplane jet engines and the propellers on ships

Mars airplane

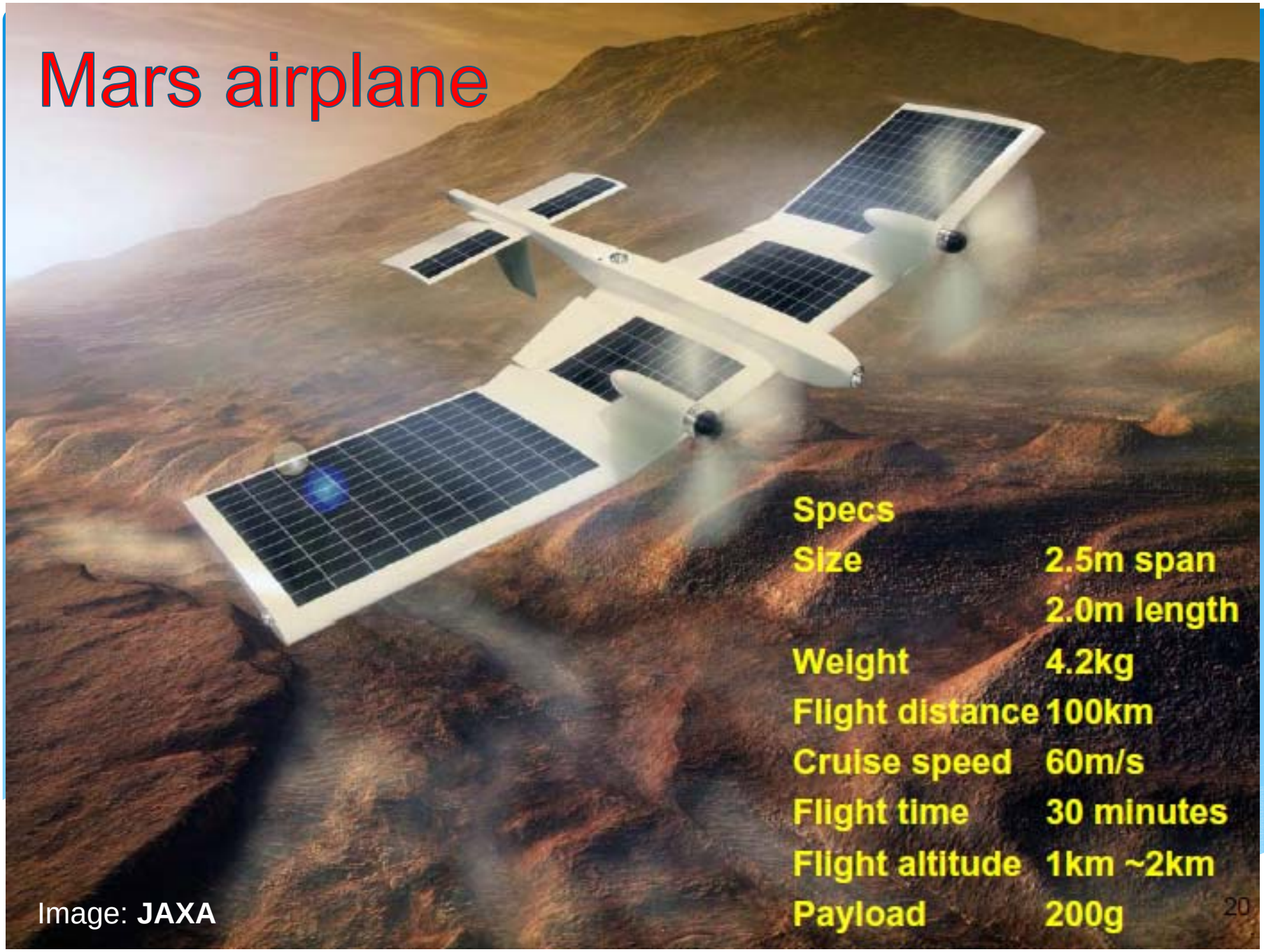
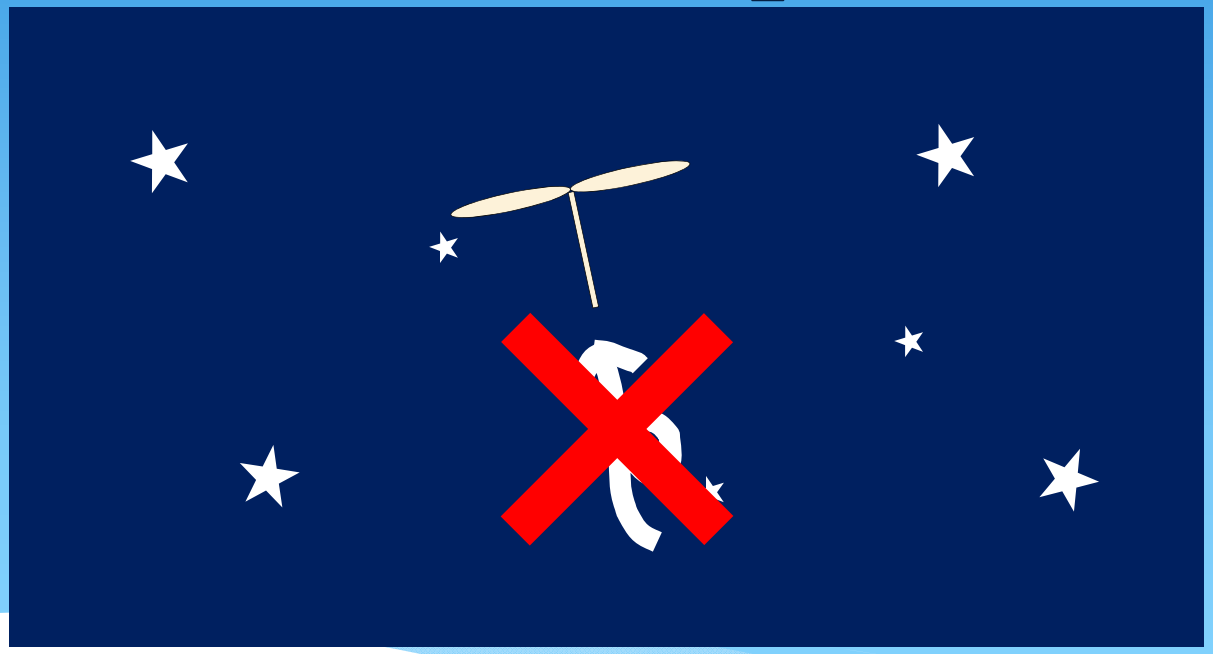


Image: **JAXA**

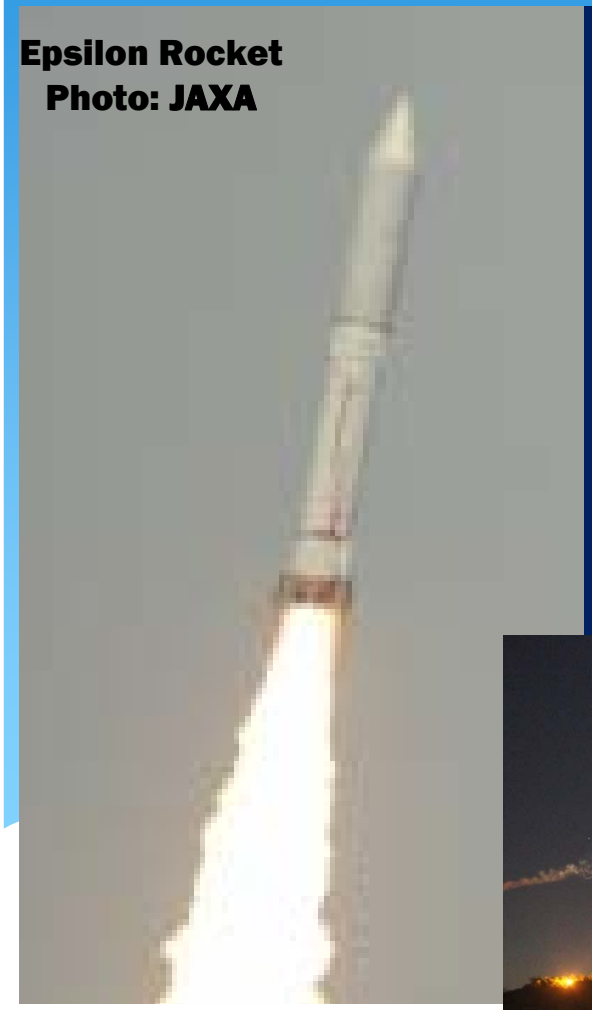
Question 4
”Can we use a Propeller Stick in space?”



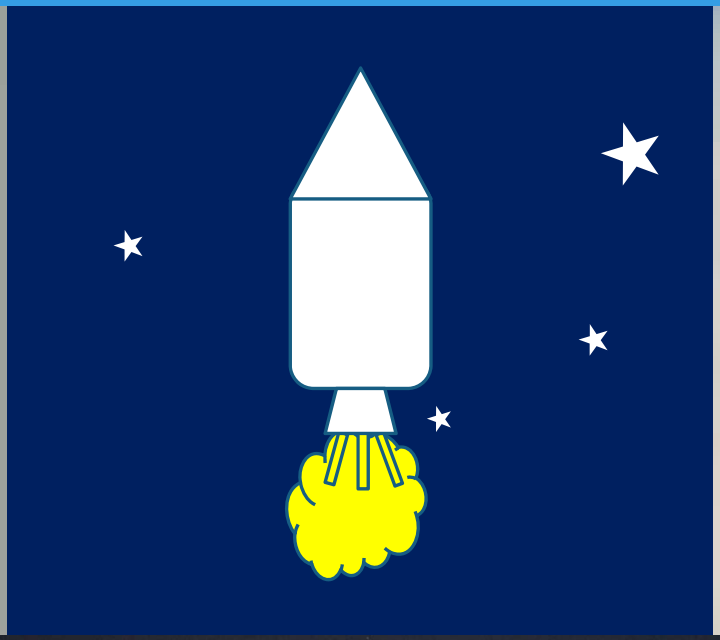
There is no air

We can’t use a propeller

Rockets expel gas instead of having propellers



Epsilon Rocket
Photo: JAXA



H2B Rocket gas plume , Photo from Okinawa

H2A Rocket
Photo: JAXA

Explanation of fundamental rocket principles
Dry Ice Rocket

Photo: In Haebaru town Parents/Kids Class
(with permission from Tsuyoshi Yonamine)

Put dry ice and water in the plastic bottle to make it fly

Photo: In Takamine junior high school

Put dry ice and water in the film case to make it fly

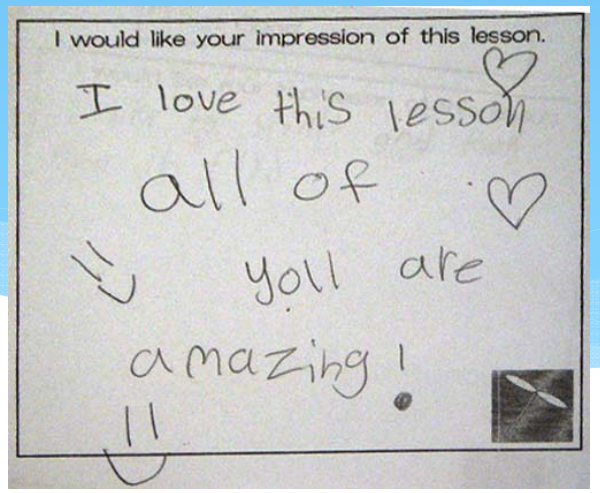
Comments from students 7th graders at Takamine Junior High School

5.	Great fun	33
4.	Fun	4
3.	Neither	0
2.	Boring	0
1.	Very boring	0

Comment "Found out that a Propeller Stick won't fly unless its wings are turned up, and also learned about rockets."

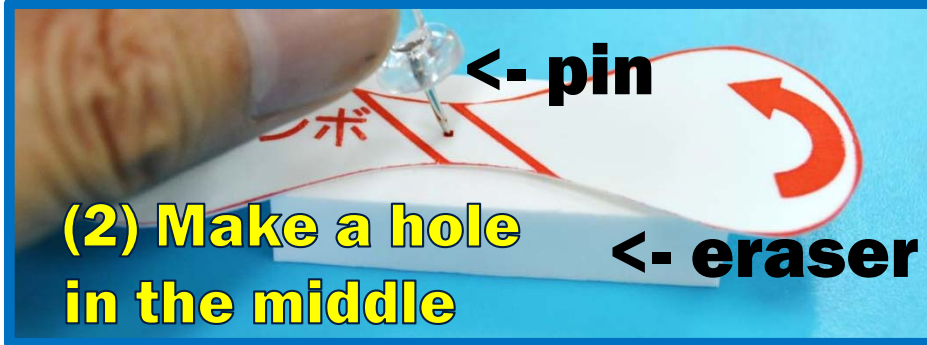
Comments from students 4th graders at Ward elementary school in Houston

Excellent	**21**
Very Good	**4**
Good	**3**
Not Good	**0**



Let's make our “Platombo”

(1) Cut it out

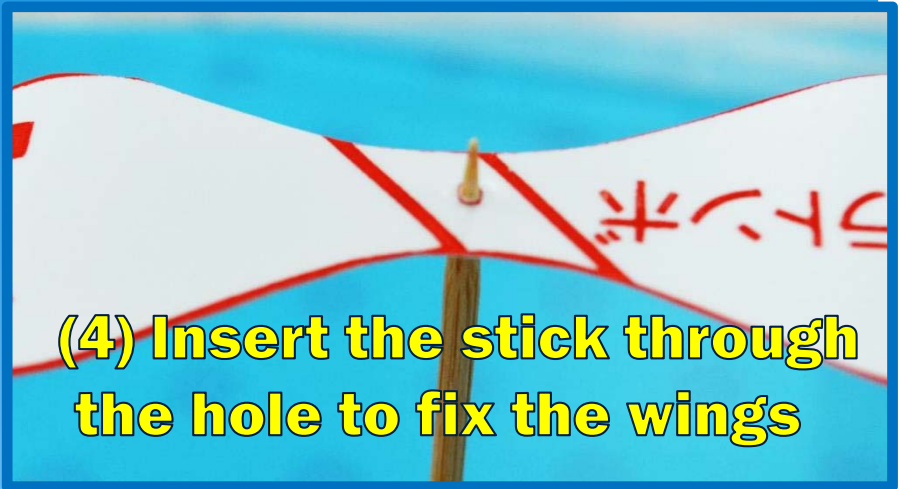


<- pin

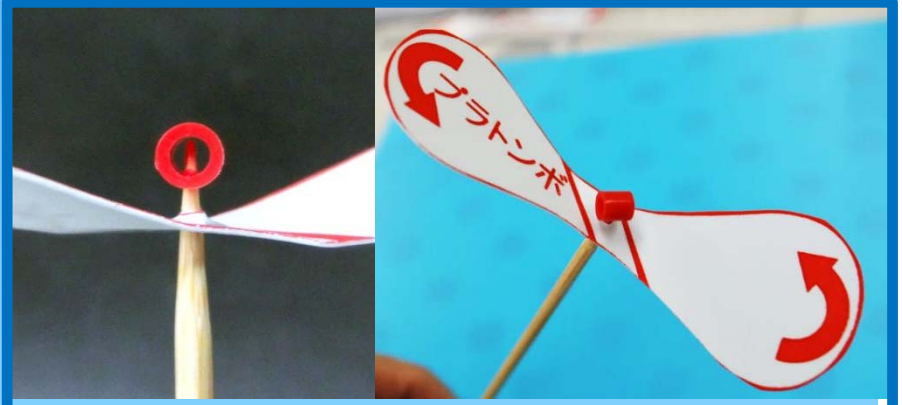
(2) Make a hole in the middle

<- eraser

(3) Put a ruler on the lines and fold the Wings upwards (2place)



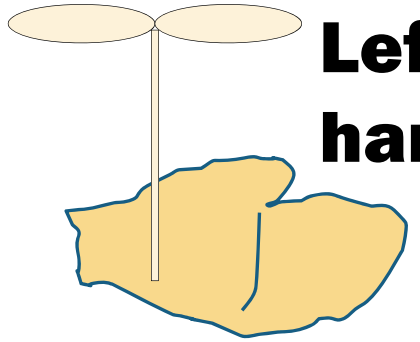
(4) Insert the stick through the hole to fix the wings



(5) Use the pin to Make a hole on the outside of the iron on bead and put it on the tip of the stick (for safety)

Let's fly our “Platombo“

(1)

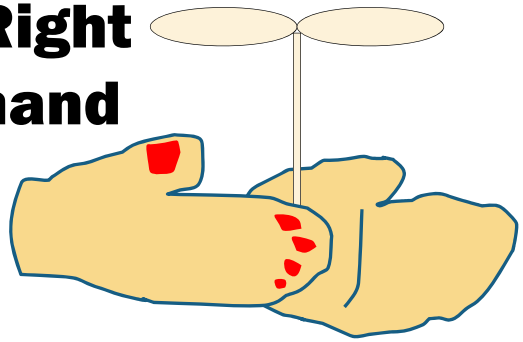


Left hand

(1) Place the stick against the bottom of your left hand

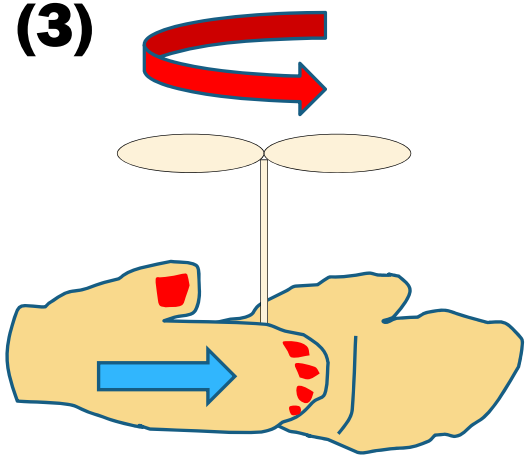
(2)

Right hand



(2) Hold the stick down with the tip of the fingers on your right hand

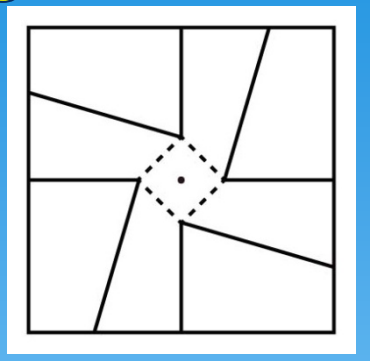
(3)



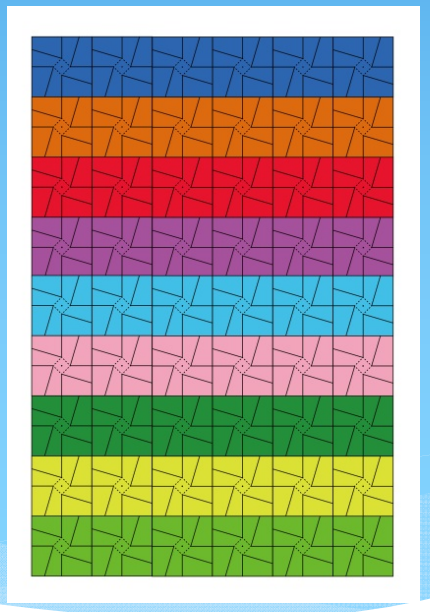
(3) Slide your right hand forward
(slowly at first,
then build up speed)

(4) Shout “Platombo!" as you release it.

Souvenir 1
Blow-spin top



template



Conceived by: Yutaka Yamauchi*4,
refined by Akira Saka*5,
further refined by Manabu Fujita*6

Print a template on an OHP sheet for ink jet printer

How to make a blow-spin top

(1) Print a template on an OHP sheet

(2) Cut the template out

(3) Fold upwards along the dotted lines

(4) Press a ballpoint pen on the dot in the middle from above to make an indent

How to make it fly

(1) Use a straw, and blow.

(2) At first, blow slowly

(3) Gradually blow harder to make it spin faster

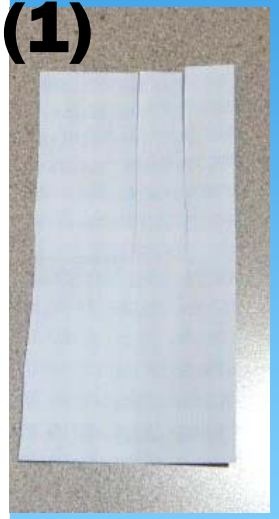
(4) Once it's spinning fast, stop blowing

Souvenir 2

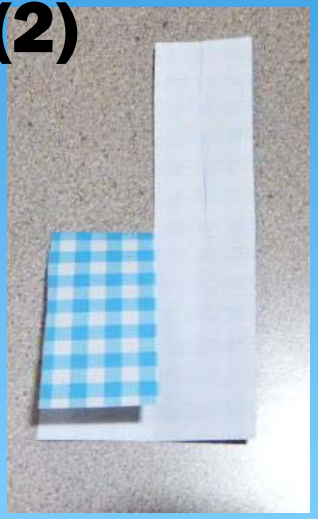
Japanese origami“kurukurushuttle”

(A model of dipterocarp seed)*7

(1)



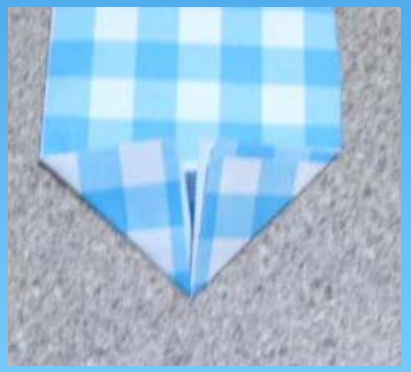
(2)



(3)

(4)

(5)



(6)

put sticker

(7)

back

(8)

That's the end of my talk.
Thank you for your attention.

出典

※1　阿部昭徳「プラトンボを飛ばそう！材料と起源，そして人のつながり」，
たのしい授業編集委員会編『ものづくりハンドブック7』（仮説社,2009）
※2　板倉聖宣『仮説実験授業のABC（第5版）』（仮説社，2011）
※3　与那嶺剛　ブログ「たのしい〈科学・実験〉教室」より
2015/8/24『放課後子ども教室　「ぐるぐる回って　空を飛ぶ」』
（http://yonatuyo.blog.fc2.com/blog-entry-30.html）
※4　山内豊『おもちゃをつくろう』（筑摩書房，1979）
※5　坂明「プラバンでつくるプロペラごま」，たのしい授業編集委員会編『ものづくりハンドブック1』（仮説社，1988）
※6　藤田学「吹きゴマを吹いて回して飛ばしてみよう」，『青少年のための科学の祭典2015』
※7　伊藤善朗「体育系!?　折り紙あそび「くるくるシャトル」を紹介します」，
たのしい授業編集委員会編『ものづくりハンドブック9』（仮説社,2015）

プラトンボの材料入手先
仮説社　（　http://www.kasetu.co.jp/　）
品名：「プリントプラトンボ」（PPシートのみ），
「プラトンボ用竹串＆ビーズ」（竹串とビーズのみ）

発表原稿

Plan for a class using "Plastic Propeller Stick"

Script for <Flying Around the Sky>

SEEC2016

Tomohiko Aikawa (teacher at a junior high school in Okinawa)

Slide 1

Good morning everyone. My name is Tomohiko Aikawa, and I'm a science teacher at a junior high school in Okinawa, Japan.

Today I'd like to present to you a plan for a lesson called "Flying Around the Sky" using a plastic Propeller Stick.

Slide 2

First, allow me to introduce myself. Here you can see a map of Japan. Does anyone know where Okinawa is? The islands in the very far south of Japan make up Okinawa prefecture.

Slide 3

Okinawa was originally known as the Ryukyu Islands, and it once flourished as a trading link between China and mainland Japan. As a result, it has a fusion of cultures from a range of countries, and to this day it still has unique architecture and culture including Shuri Castle and Ryukyu dancing.

Slide 4

The school that I work at is called Takamine Junior High School, and it is in Itoman city in Okinawa prefecture. It is located in the south of Okinawa's main island. It has 156 students, making it a smaller than average school in Japan.

Slide 5

Takamine Junior High School is on the grounds of the remains of Nanzan Castle that is thought to have been built in the 14th century. In the school district, there is also a harvest festival called "Maezato tug of war" that has continued for 300 years.

Slide 6

Space education is very popular in Okinawa. Up to now, four teachers including myself

have participated in SEEC. This is a message of support written by the students of Takamine Junior High School to the New Horizons, an interplanetary space probe. It says "We can't wait for the results of the mission" and "NASA is my hero!" The students love space!

Slide 7

OK, now I would like to introduce the course materials. This is a bamboo Propeller Stick. It's a traditional toy in Japan, which we call bamboo dragonfly, because it looks like a dragonfly. There are many bamboo forests in Japan, and there are a range of crafts that use bamboo.

Slide 8

A plastic Propeller Stick is based on the bamboo Propeller Stick, and can be simply constructed from plastic. It was conceived by Masaki Ando and Noriaki Abe.

It is used in classes in many elementary and junior high schools in Japan. I will now make it fly.

Slide 9

I'll now explain how this plastic Propeller Stick can be useful in space education. I'd like to introduce a lesson plan for space education called "Flying Around the Sky" based on the approach of hypothesis-experiment-lesson.

"Hypothesis-experiment-lesson" is an approach to science education first proposed by Kiyonobu Itakura of the National Institute for Educational Policy Research in 1963. It allows students to learn the fundamentals of science through a serious of problems that involve making a hypothesis and then performing an experiment.

This lesson is mainly intended for ages 8 and above.

This lesson plan was conceived by Tsuyoshi Yonamine, the former principal of Yonabaru Higashi elementary school in Okinawa, in 2015. It is currently being studied by a group mainly comprised of members of Okinawa's "Hypothesis-experiment-lesson Study Group".

Slide 10

Please allow me to explain the flow of the lesson. We compare the two propeller sticks A and B. Let's try making them fly. The result is that A flies.

Slide 11

First, as Question 1, Do you know what the difference is? (The expected response is that

A's wings are angled, or the wings are folded, etc.) That's right, A's wings have an angle. It flies because the wings are angled. If the wings are straight like in B, then it won't fly.

Slide 12

I'll explain this using fans. Spinning the one with straight wings doesn't produce any wind. But spinning the one with wings at an angle does produce wind.

Slide 13

Because the air flows downward, the plastic Propeller Stick moves in the opposite direction, that is to say upward.

Slide 14

I'll explain airflow using dry ice. If you put dry ice and water in a plastic bottle, it produces white smoke. The air flows downward when the Propeller Stick is spun.

Slide 15

Next, let's consider the airflow from a propeller using a model of an airplane.

This is a model of an airplane.

By spinning the propeller with a rubber band, you can see that it generates an airflow.

Slide 16

Next is Question 2. Will this airplane go (A) forward? Or (B) backward? Or(C)It won’t move?

Slide 17

Put your hand up if you think it will go forward. And put your hand up if you think it will go backward. And put your hand up if you think it won’t move.

Why do you think so? (Expected response: because it's the same as the Propeller Stick)

OK, let's try an experiment. 3...2...1... as you can see, it went forward.

Slide 18

So in other words, an airplane's propeller works in the same way as a Propeller Stick.

In Japanese animation, there is a robot cat character that has a bamboo Propeller Stick-shaped propeller on its head. This is a toy of this character. It can also produce a downward airflow when it spins. What do you think will happen when I left it go?

Let's have a look. 3...2...1... it flies!

This is the same as the Propeller Stick.

Slide 19

And next is Question 3. This is an electric fan. "If you put wheels on an electric fan, will the electric fan move?" Students consider the airflow from a propeller.

Slide 20

Which prediction do you think it's true: A) It moves forward, B) It moves backward, C) It won't move? Put your hand up if you think it is A. Put your hand up if you think it is B, and put your hand up if you think it is C.

Slide 21

OK, let's take a look at a video of the experiment. The electric fan moved backwards.

You can see that it moves in the opposite direction to the airflow.

Slide 22

Through this series of questions, children will develop an internal hypothesis that if a propeller is used then the air flows in the opposite direction.

Slide 23

The fundamental principle of airplane jet engines and the propellers on ships is the same as this.

Slide 24

This is a Mars airplane that JAXA is researching. Mars also has an atmosphere, so it can fly with a propeller.

Slide 25

Finally, Question 4. “Can we use a Propeller Stick in space?”

(Expected answers: " There‘s no air in space so we can't use a propeller.")

That's right.

Slide 26

There's no air in space so you can't use a propeller. That's why rockets expel gas to make themselves fly.

Slide 27

As an explanation, I'll use the model rockets, or I'll use dry ice we used previously to make a dry ice rocket. The dry ice rocket is made from a plastic bottle and film case. This allows children to understand how rockets work.

Slide 28

These are the comments of the children who have taken the class. Many students said they had great fun. There were also comments saying that they had managed to learn how the Propeller Stick and rockets work.

Slide 29

Yesterday, We went the Ward elementary school in Houston, and students have taken the class. Many students said “Excellent”

In this way, it is possible to develop space education using the Propeller Stick.

Slide 30

Let's make our plastic Propeller Stick fly. The material is a Polypropylene sheet. The covers of plastic folders, etc. can be used. We also need a stick and iron on beads.

Here, I've already made it halfway. You have an example and a set of instructions on your desk.

1. Please cut the sheet along the lines marked. 2. Next, use the pin to make a hole in the middle. When doing so, please put an eraser or other protective item on the desk. Don't make any holes in the desk! 3. Fold upwards along the line in the middle. It's easier to fold here if you use a ruler. You should make folds in two places. 4. Insert the stick into the hole to fix it in place.

5. Make a hole on the outside of the iron on bead. Push the stick into the middle of the bead.

And with that, you're ready to go.

Slide 31

This is how you fly the plastic Propeller Stick. 1. Place the stick against the bottom of your left hand. 2. Hold the stick down with the tip of the fingers on your right hand. 3. Slide your right hand forward to make the plastic Propeller Stick spin in the direction of the arrow. Start slowly at first and then gradually build up speed. Shout "Platombo!”（Go Dragonfly!）as you release it.

Slide 32

Finally, as a souvenir, I'd like to introduce this "blow-spin top". Let's try making it fly.

If you blow on it like this, it spins in the same way as the plastic Propeller Stick, and flies.

Slide 33

Here's how to make it. Let's try making one together. (1) There is a template printed on the OHP sheet, please cut this out. (2) Next, fold it upwards along the dotted lines. (3) Finally, make a spinning axis by pressing a ballpoint pen on the dot in the middle from above. And with that, you're ready to go.

Use a straw, and blow. Blow slowly at first. Once it's spinning, blow faster. Then when you stop blowing, the blow-spin top will fly.

Let's try it.

That's the end of my talk. Thank you for your attention.

配布資料

SEEC2016

Plan for a class using "Plastic Propeller Stick"

Script for <Flying Around the Sky>

based on the approach of “Kasetsu Jikken Jugyo”
(hypothesis-experiment-lesson).

Tomohiko Aikawa (teacher at a junior high school in Okinawa,Japan)
(A members of Hypothesis-experiment-lesson Study Group)

1. About this plan for a class

" Kasetsu Jikken Jugyo “ -Hypothesis-experiment-lesson- is an approach to science education first proposed by Kiyonobu Itakura of the National Institute for Educational Policy Research in 1963. It allows students to learn the fundamentals of science through a serious of problems that involve making a hypothesis and then performing an experiment. *1

Lesson plan for a class using "Plastic Propeller Stick" script for <Flying Around the Sky> was conceived by Tsuyoshi Yonamine, the former principal of Yonabaru Higashi elementary school in Okinawa prefecture, in 2015. *2

It is currently being studied by a group mainly comprised of members of Okinawa's Hypothesis-experiment-lesson Study Group. This lesson is mainly intended for ages 8 and above.

2. About “Platombo” -Plastic Propeller Stick-

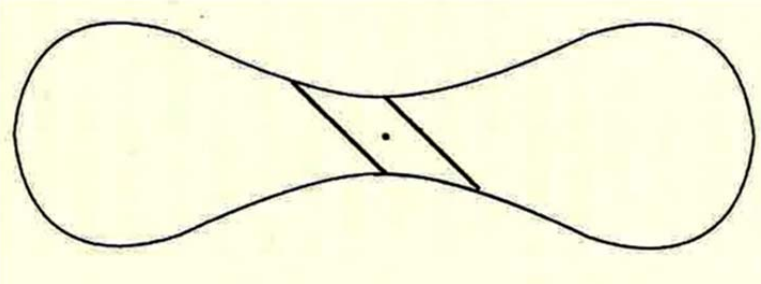
A “Bamboo Propeller Stick” is a traditional toy in Japan, which we call “Taketombo” -bamboo dragonfly-, because it looks like a dragonfly (Tombo). There are many bamboo (Take) forests in Japan, and there are a range of crafts that use bamboo. “Platombo” -a plastic Propeller Stick- is based on the bamboo dragonfly, and can be simply constructed from plastic. It was conceived by Masaki Ando (Associate Professor at Shokei Gakuin University)

and Noriaki Abe (elementary school teacher in Miyagi prefecture) *3
It is used in classes in many elementary and junior high schools in Japan.

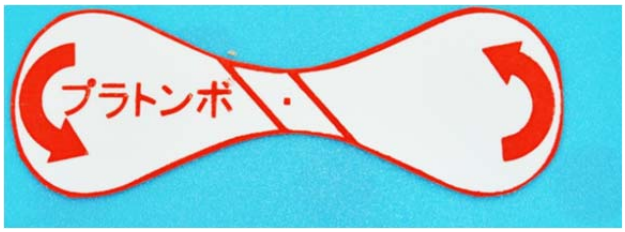
3. Making a plastic Propeller Stick

The material is a Polypropylene sheet. The covers of plastic folders, etc. can be used.
We also need a bamboo stick and iron on beads.

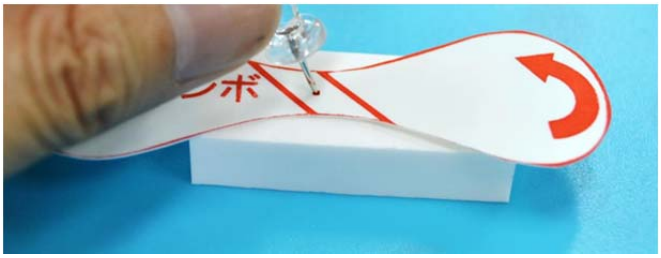
1． Copy this pattern into a polypropylene sheet. (full size)



2. Cut the sheet along the lines marked.

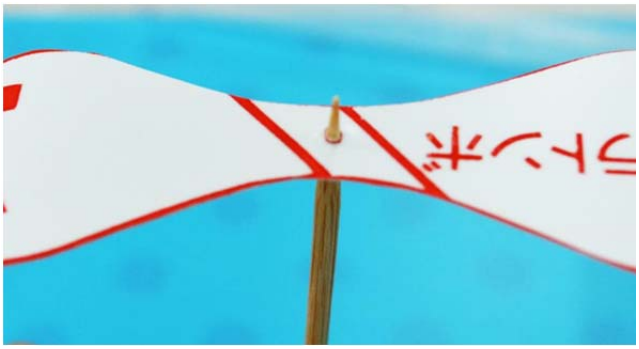


3. Use the pin to make a hole in the middle. When doing so, please put an eraser or other protective item on the desk. Don't make any holes in the desk.



4. Fold upwards along the line in the middle. It's easier to fold here if you use a ruler. You should make folds in two places.

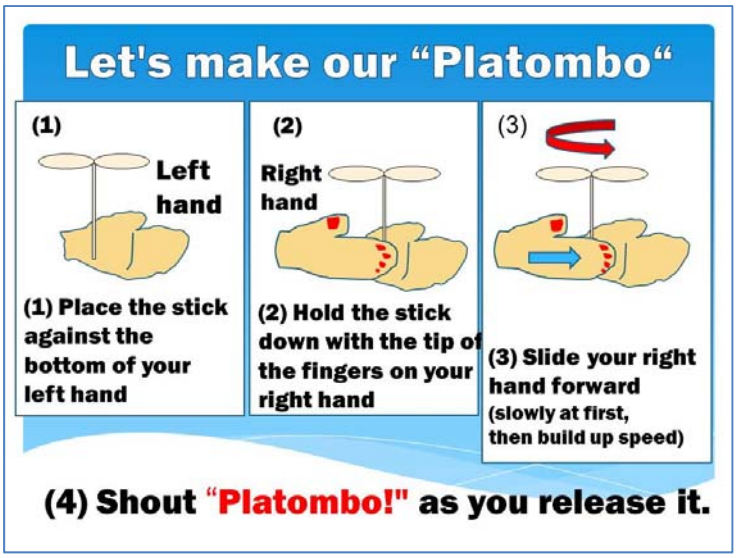
5. Insert the stick into the hole to fix it in place.



6. Make a hole on the outside of the iron on bead and put it on the tip of the stick (for safety reasons)

4. Let's make our Propeller Stick fly.

1. Place the stick against the bottom of your left hand.
2. Hold the stick down with the tip of the fingers on your right hand.
3. Slide your right hand forward to make the plastic Propeller Stick spin in the direction of the arrow. Start slowly at first and then gradually build up speed.
4. Shout "Platombo!" as you release it.



5. The flow of the lesson

Please allow me to explain the flow of the lesson.

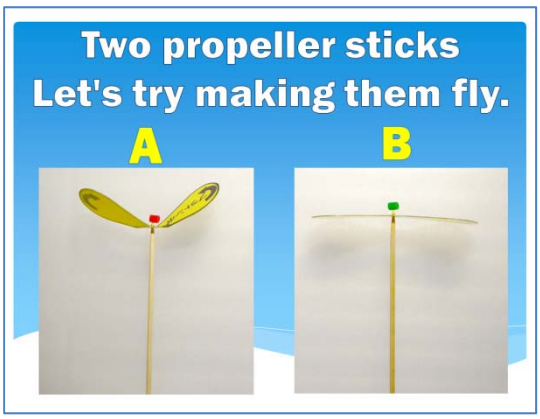
First, teacher compare the two propeller sticks A（angled）and B（straight）, and tries making them fly.

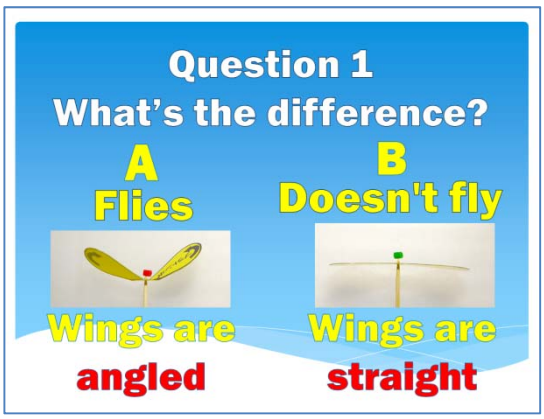
The result is that A flies, B doesn't fly.

Next, Teacher asks students. "Do you know what the difference is?"

(The expected response is that A's wings are angled, or the wings are folded, etc.)

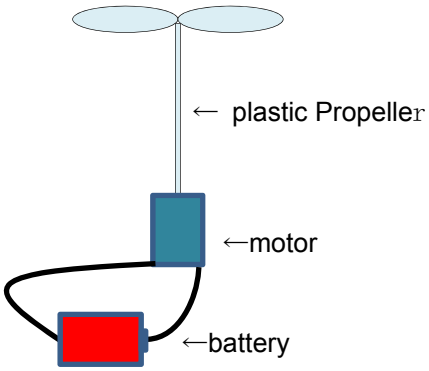
A's wings have an angle. It flies because the wings are angled. If the wings are straight like in B, then it won't fly.

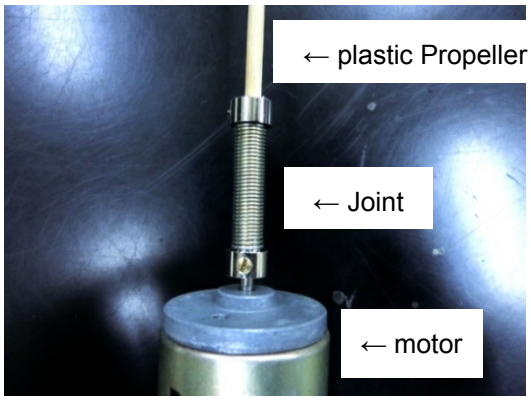


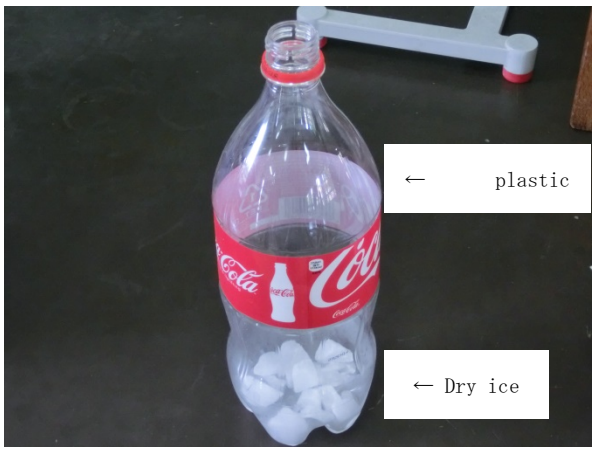


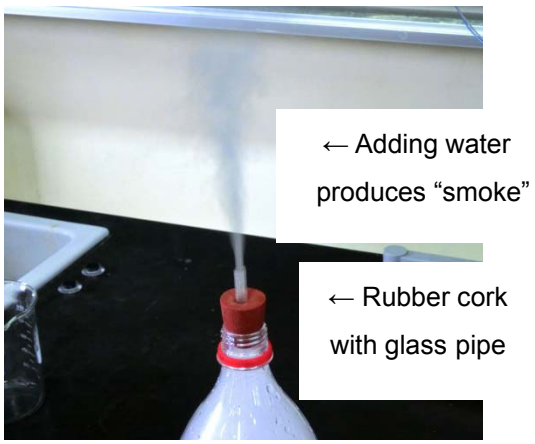
Teacher explains this using fans. Spinning the one with straight wings doesn't produce any wind. But spinning the one with wings at an angle does produce wind.

Teacher can explain airflow using dry ice. If you put dry ice and water in a plastic bottle, it produces “white smoke”.



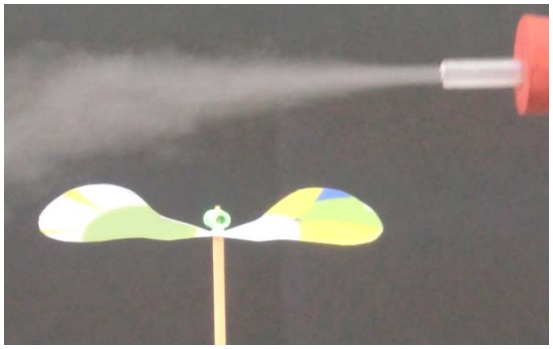






Put dry ice and water in a plastic bottle

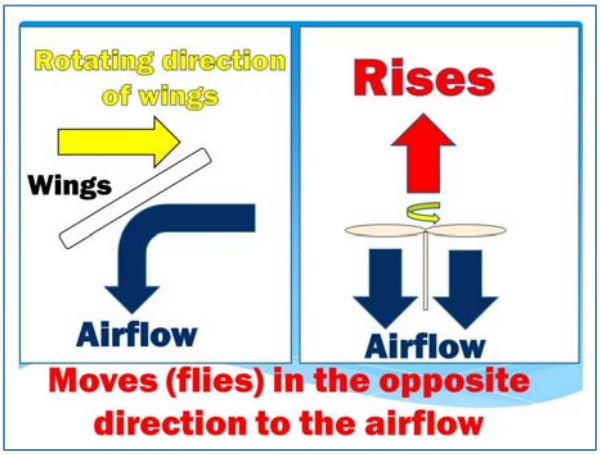
The air flows downward when the Propeller Stick is spun.



Stoped (smoke flows past)

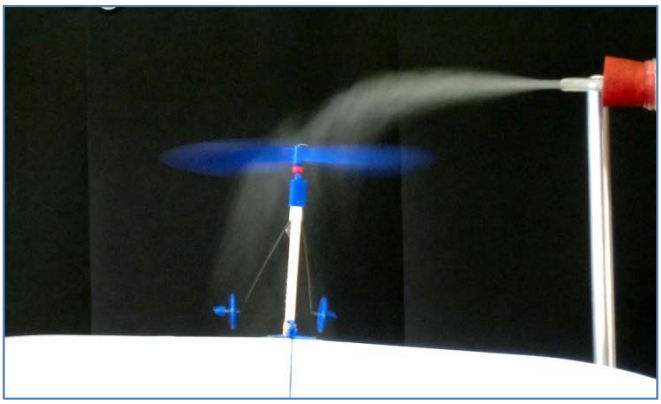
Spinning (Smoke flows downward)

Students learn that spinning the one with wings at an angle does produce wind.



6. Using a model of an airplane

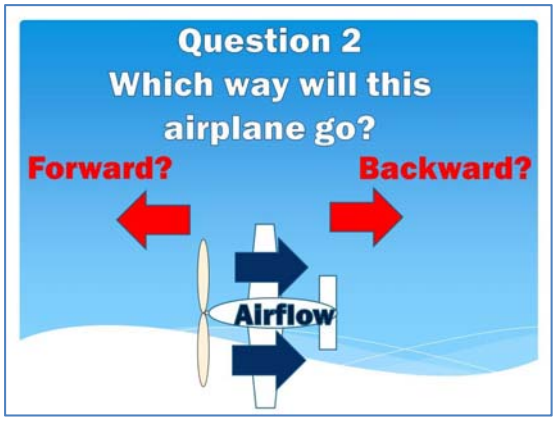
Next, Students consider the airflow from a propeller using a model of an airplane. By spinning the propeller with a rubber band, you can see that it generates an airflow.

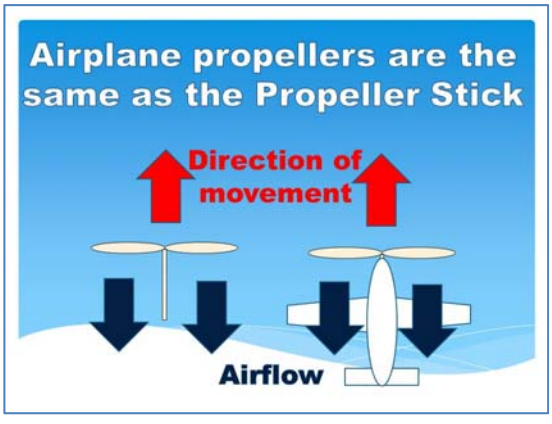


And as for question 2. Teacher asks the students." Will this airplane go forward? or backward? Put your hand up if you think it will go forward. And put your hand up if you think it will go backward. Why do you think so?"

(Expected response: because it's the same as the Propeller Stick.)

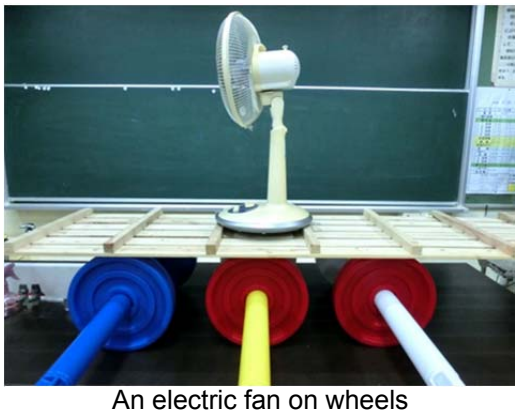
And students try an experiment. They can see, it went forward.



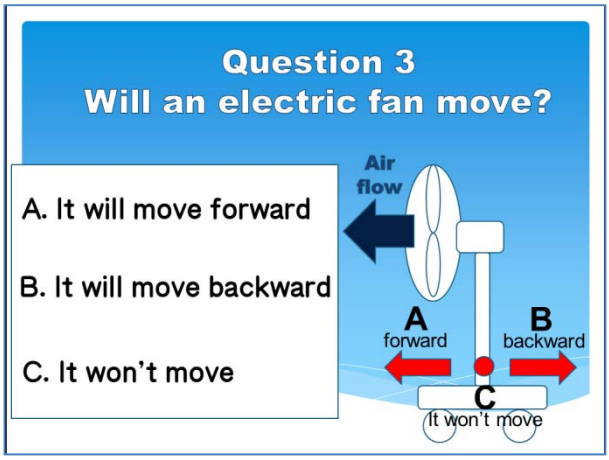


7. Using an electric fan with wheels

And next is Question 3. Teacher questions students. "If you put wheels on an electric fan, will the electric fan move? Which prediction do you think is true: A) It moves forward, B) It moves backward, C) It won't move? Put your hand up if you think it is A. Put your hand up if you think it is B, and put your hand up if you think it is C. " Students consider the airflow from a propeller. And students try an experiment. They can see, it went backward.



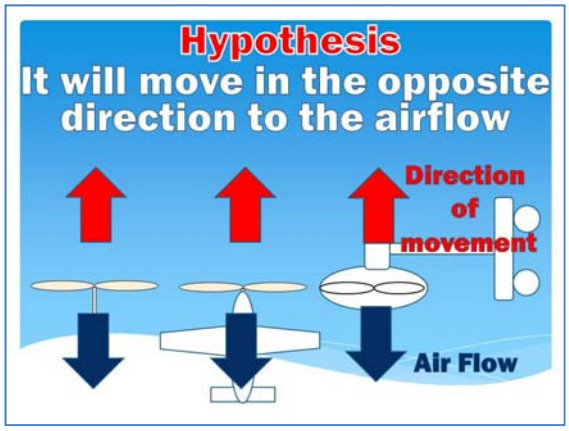
An electric fan on wheels



Wheels are made by plastic pole and wood duckboards. (Big wheels can experiment brevity)

8. Developing a hypothesis

Through this series of questions and experimentations, children will develop an internal hypothesis that if a propeller is used then the air flows in the opposite direction. Students learn that the fundamental principle of airplane jet engines and the propellers on ships is the same as this. Mars also has an atmosphere, so “Mars airplane” can fly with a propeller.



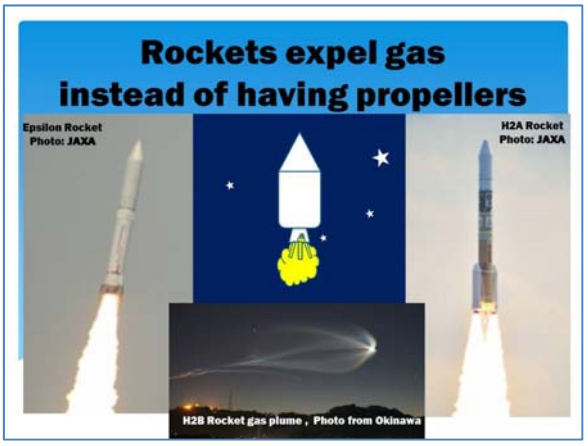
A Mars airplane that JAXA is researching

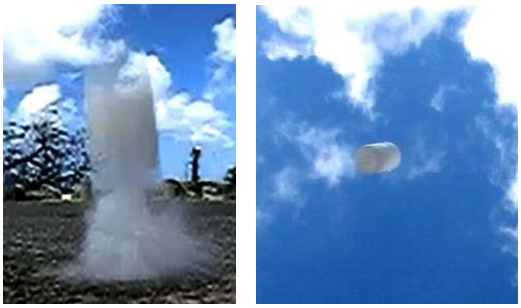
9. Understanding how rockets work

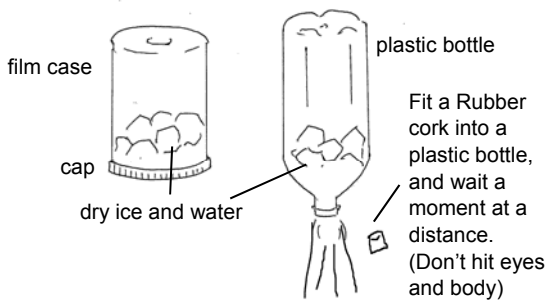
Finally, Question 4. “A Propeller Stick cannot fly in the space. Do you know why?” (Expected answers: "because there is no air," "because it's a vacuum")

There's no air in space so you can't use a propeller. That's why rockets expel gas to make themselves fly.

As an explanation, Teacher will use a model rocket (or water rocket, or use the dry ice we used previously to make a dry ice rocket. The dry ice rocket is made from a plastic bottle and film case). This allows children to understand how rockets work.





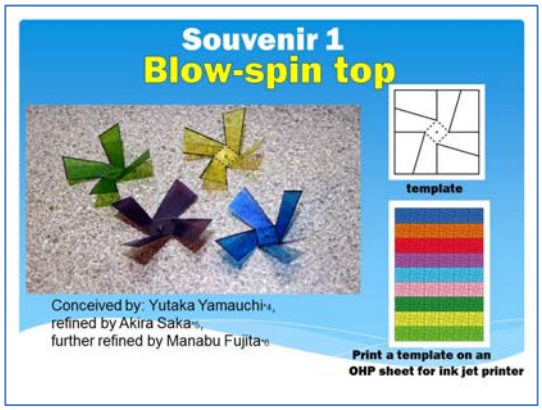


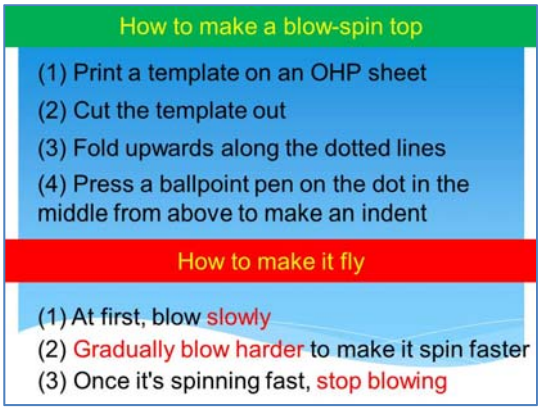
Dry ice rocket is made from a plastic bottle and film case

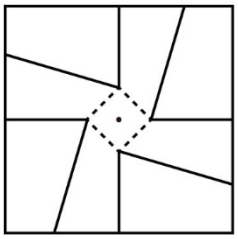
10. Other teaching materials

I'd like to introduce this "blow-spin top" conceived by Yutaka Yamauchi,Akira * 5 , refined by Akira Saka* 6 , further refined by Manabu Fujita* 7

If you blow on it like this, it spins in the same way as the plastic Propeller Stick, and flies. And I'd like to introduce Japanese Origami "Kurukurushuttle" conceived by Yoshiro Ito.*6　It is like a seed of dipterocarp that rotates.







11. Comments of the students

These are the comments of the studends who have taken the class. Many students said they had great fun. There were also comments saying that they had managed to learn how the Propeller Stick and rockets work.

5. Great fun	33
4. Fun	4
3. Neither	0
2. Boring	0
1. Very boring	0

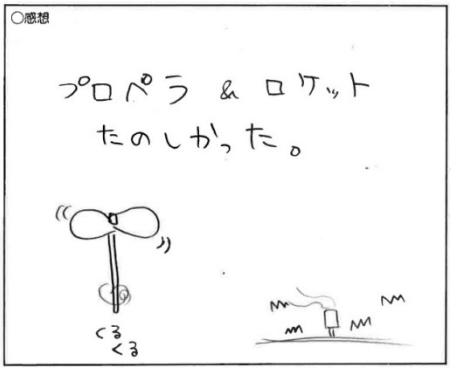
Comments from students (7th graders) at Takamine Junior High School

Example1

プラトンボの羽が上にまがっていないと飛ばなかったり，ロケットのことについてもよく知ることができました。

“Found out that a Propeller Stick won't fly unless its wings are turned up, and also learned about rockets.”

Example2

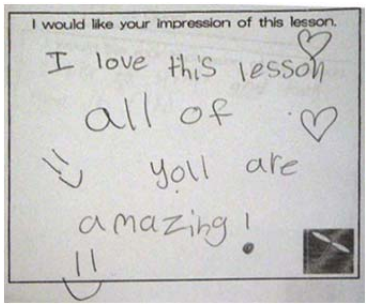


“Propeller Stick and rocket work are very fun.”

Yesterday, We went the Ward elementary school in Houston, and students have taken the class. any students said “Excellent”

Excellent	21
Very Good	4
Good	3
Not Good	0

Comments from students (4th graders) at Ward elementary school in Houston



In this way, it is possible to develop space education using the Propeller Stick.

12. 出典（Reference materials）

※１　板倉聖宣『仮説実験授業のＡＢＣ（第５版）』（仮説社，2011）
※２　与那嶺剛　ブログ「たのしい〈科学・実験〉教室」より
2015/8/24『放課後子ども教室　「ぐるぐる回って　空を飛ぶ」』
（http://yonatuyo.blog.fc2.com/blog-entry-30.html）
※３　阿部徳昭「プラトンボを飛ばそう！材料と起源，そして人のつながり」，
たのしい授業編集委員会編『ものづくりハンドブック７』（仮説社,2009）
※４　山内豊『おもちゃをつくろう』（筑摩書房，1979）
※５　坂明「プラバンでつくるプロペラごま」，たのしい授業編集委員会編『ものづくりハンドブック１』（仮説社，1988）
※６　藤田学「吹きゴマを吹いて回して飛ばしてみよう」，『青少年のための科学の祭典 2015 資料』
※７　伊藤善朗「体育系!?　折り紙あそび「くるくるシャトル」を紹介します」，
たのしい授業編集委員会編『ものづくりハンドブック９』（仮説社,2015）

●プラトンボの材料入手先
（A supplier provides materials for this Plastic Propeller Stick）

仮説社(Kasetusha)　http://www.kasetu.co.jp/

「プリントプラトンボ」
“Print platombo”（sheat only ,42cuts）

「プラトンボ用竹串＆ビーズ」
（bamboo stick and iron on beads,42）