

The World of illusion

Okayama prefectural Kurashiki Washu high school

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Thank you very much Kenta Nomura.
Hello, everybody.

Can you hear me ? Can you see me ?

Self-introduction

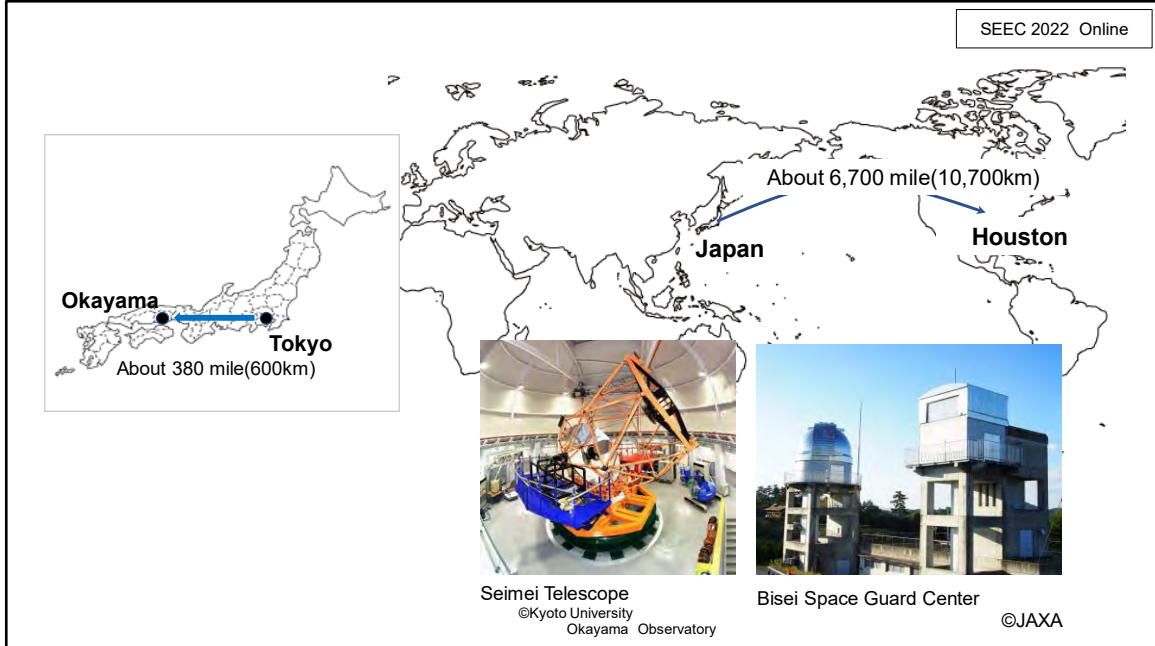
- ★ Name: Hisahiko YAMAMURA
- ★ Address: Okayama prefecture, Japan
- ★ Organization:

Kurashiki Washu high school
- ★ Subject: Science



First, let me introduce myself.

My name is Hisahiko Yamamura. I live in Okayama Japan. Currently I work for Kurashiki Washu High School. The photo above shows the school building seen from the school gate, and the photo below shows the morning sun seen from the school building. The school is located on a little hill with a view. I'm in charge of science.



Next, I'm going to introduce Okayama.

The distance from Japan to Houston is about 6,700 mile (10,700 km). I live in Okayama prefecture, which is about 380mile(600 km) west of the Japanese capital, Tokyo.

The prefecture has many sunny days and is called "Sunny Day Okayama." For this reason, the Seimei Telescope, one of the largest in East Asia, has been installed for supernova observation. It is also the prefecture where the Space Guard Center has been set up to observe space to protect Earth from asteroids day and night. I'm taking to all of you a place where I feel close to the topic of space and enjoy science very much.

Today's Presentation

1. What is an illusion?
2. illusion and Space
3. Let's Enjoy illusions More.

Part 1 : Benham's top -- Let's spin it --

Part2 : Let's build a Strange Slope (papercraft)

4. Summary

Now, let me begin today's presentation.

I would like to talk about illusions. There are many illusions around you. Illusions are brain trick, but these are actively used in life onboard the International space station.

Here is the agenda for my presentation. I'm going to talk a little bit about illusions. I will also talk about the universe and illusions, and we are going to enjoy illusions around ourselves. We will spin a Benham's top and make a strange slope which is simple papercraft. I will just show you how to make it due to constraints of time today. Lastly, I will conclude with a summary.

1. What is an illusion?

I know it's sudden, but...

I have Questions.



First, let's look at illusions.

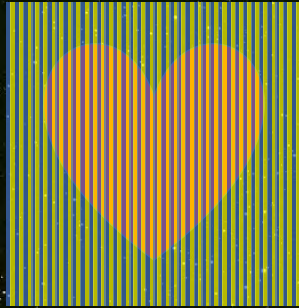
I know it's sudden, but I have a few questions.

The answers differ from person to person, so there is no correct answer.

1. What is an illusion?

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© Photo by Tamio Tsuboi, March 20, 2016 Orion



A



B



C

**Question 1: Which is the same color
as the leftmost heart?**

Question 1: Which is the same color as the leftmost heart?

Can you type text your answer in the chat box?

Those who answered A are []

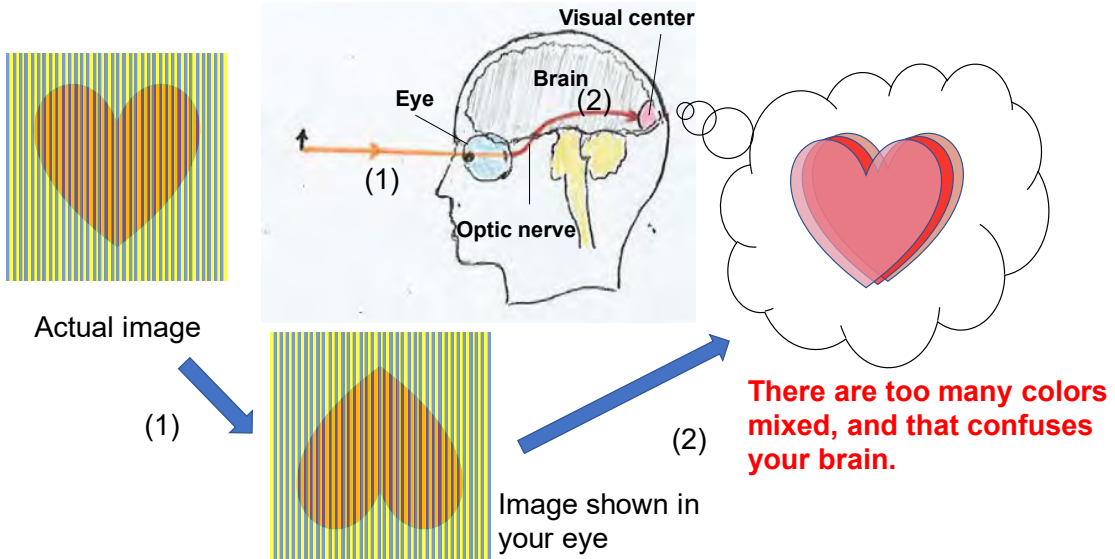
The most answer is []

Now let's see what the actual answer is.

The answer is C.

How was it? Those who thought A or B was the answer were confused by an illusion.

1. What is an illusion?



When humans recognize light and see things, it is called vision.

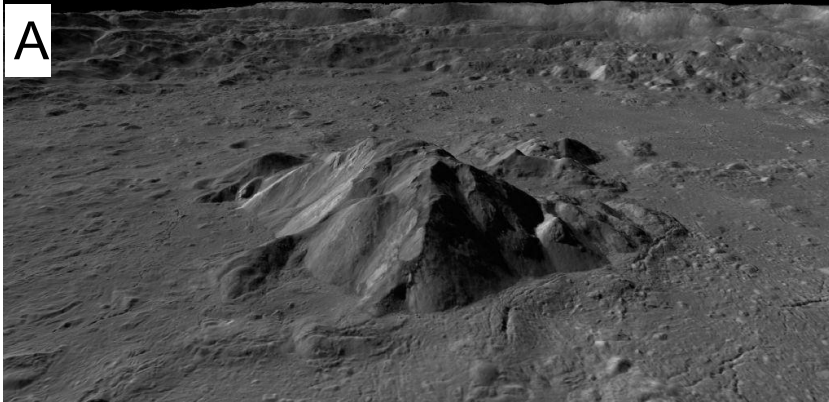
In human vision, the image on the eye does not become visual as it is, but various information is processed in the brain on the way. Information processing by the brain makes things look different from what they are.

In this case, the color of the original heart and the colors of the front stripes are mixed up so much that your brain is confused. That is why people see things differently.

1. What is an illusion?

Question 2 - How does it look?

© JAXA/SELENE

**Is it a Mountain or a Valley ?**

Question 2. The photo A shows the surface of the moon taken by the lunar orbiter Kaguya (SELENE).

What does it look like? Is it a Mountain or a Valley ?

Can you type your answer in the chat box?

Those who answered mountain are []

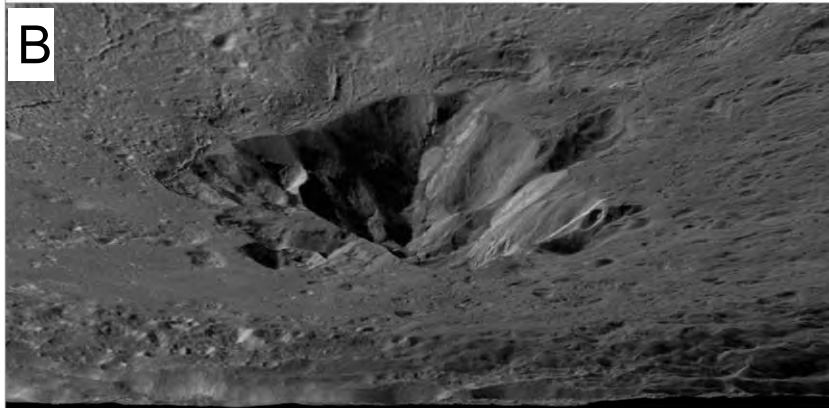
The most answer is [].

1. What is an illusion?

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Question 2 - How does it look?

© JAXA/SELENE



Is it a mountain or a valley ?

Next, what does photo B look like? Is it a Mountain or a Valley ?

Can you type text your answer in the chat box?

Those who answered mountain are []

The most answer is [].

Perhaps, the bellow photo looked like a mountain, and this photo looked like a valley.

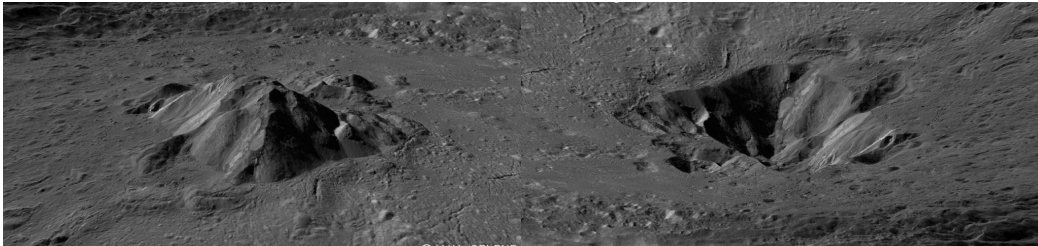
Do you see any difference between the two photos?

1. What is an illusion?

Question 2 - How does it look?

A

B



© JAXA/SELENE

I put Photo A and B side by side.

The answer is ...! (click)

1. What is an Illusion?

Question 2 - How does it look?

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B

A

The left photo is an image of the right photo turned upside down.

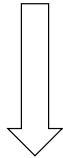
The left photo is an image of the right photo turned upside down.

The human brain made its own judgment a mountain or a valley based on how the shadow is cast.

This is illusion too.

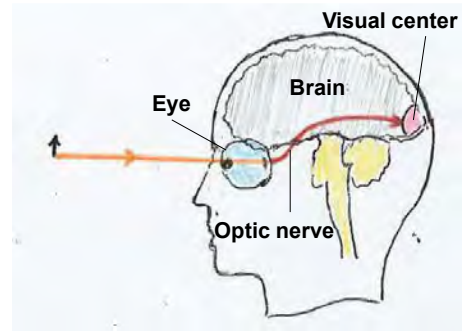
1. What is an illusion?

**Experience, physical condition,
psychological condition,
preconception.....**



Remember
these words.

**Your brain processes
the information on its own.
..... That is the “illusion.”**



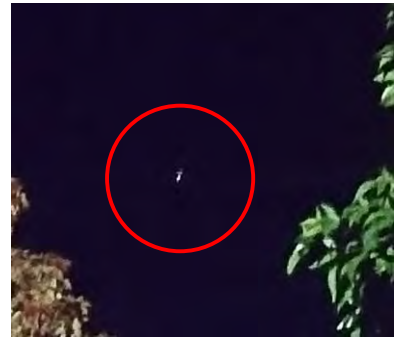
As I explained, your brain processes information in its own way based on experience, physical condition, psychological condition, and preconception. Sometimes the brain makes decisions that are convenient for you. The way something looks differently from fact is called an illusion.

2. Space and illusion

Now you may view illusions rather negatively, but illusions are effectively used in space.

This photo shows International Space Station (ISS) taken with my smartphone camera on October 6 in 2021.

illusions are effectively used
inside the ISS.



Now you may view illusions rather negatively, but illusions are effectively used in space.

I am going to focus on that from now.

This photo shows International Space Station (ISS) taken with my smartphone camera on October 6 in 2021.

Illusions are effectively used inside the ISS.

2. Space and illusion

Environment of the International Space Station (ISS)

- The atmospheric pressure is almost one.
- Temperature
- Humidity

The interior is comfortably controlled at all times.

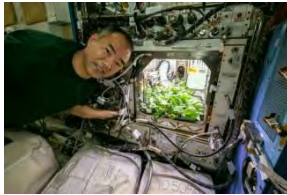
- **The apparent gravity is very small.**

Environment outside the ISS

- No air
- The temperature is $-454\sim+266^{\circ}\text{f}$ ($-270\sim+130^{\circ}\text{C}$)
- Atmospheric pressure is zero.
- The sunlight and cosmic radiation are extremely powerful.



Astronaut Hoshide performing EVA



Plant experiment device



One-person American football



Fresh food and astronaut

©JAXA/NASA

The photo on the right shows astronaut Hoshide working in space.

As you may know, the environment outside the ISS, there is no air, the temperature is between -454 and 266°f (degrees Fahrenheit) (-270° C to 130°C (degrees Celsius)), the atmospheric pressure is 0, and the sunlight and cosmic radiation are extremely powerful.

On the other hand, the environment of interior of the ISS is that the atmospheric pressure is almost one, and both the temperature and humidity are always controlled for a comfortable environment. So, you can live as if you were on Earth. These photos show the Noguchi's work and life inside the ISS. It seems very comfortable.

However, the apparent gravity remains weak because it cannot be controlled.

2. Space and illusion

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- The apparent gravity is very small.



- There is no reference for top, bottom, left or right.....



**This causes
great confusion!!**



Inside Crew Dragon

© JAXA/NASA

Now.....

The apparent gravity is very small. There is no reference for top, bottom, left and right.

For this reason, we can sense which way is the bottom because of gravity. Therefore, it causes confusion, like the photo on the right. It seems very difficult to live in this condition for a long time.

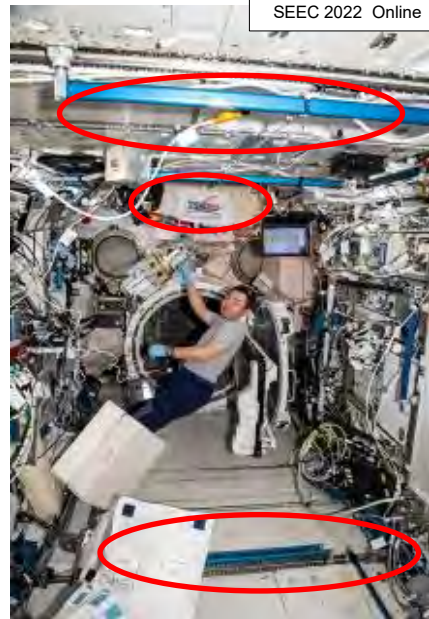
2. Space and illusion

The ISS looks like a cylinder.

The interior is square, and various measures are used to create the illusion that “this surface is the floor.”

©JAXA/NASA

In other words, this is an effective use of illusions.



Now, as shown on the left, the ISS looks like a cylinder. Its shape is based on mechanical strength.

But as I showed you earlier, the inside is also cylindrical, which then causes confusion. Therefore, the interior is square, and various measures are used to create the illusion that “this surface is the floor”. For example, like red circles in this photo, lights and decorations are provided on the upper surface, and blue lines are drawn on the lower surface.

In other words, this is an effective use of illusions to operate inside the ISS.

3. Let's Enjoy illusions More.

I wonder if there is
anything else....

It seems there are a lot more.



Illusions that make it easier to operate and stay aboard the ISS for a long time.

By the way, I wonder if there are any more illusions.....
It seems there are a lot more. Let's enjoy illusions more.
I would like to show two example.

3. Let's Enjoy illusions More.

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Part 1 - Benham's top - Let's spin it.



1. Spin it clockwise.

2. Spin it counterclockwise.

Part 1. From now on, I will show the top which is made of a marble and a CD. This top is called Benham's top, and it creates a strange illusion. Stripes are drawn on one half of the top, and the other half is painted in black. Let's spin it clockwise and counterclockwise!!

3. Let's Enjoy illusions More.

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Part 1 - Benham's top - Let's spin it. **1. Spin it clockwise.**



This movie shows the Benham's top spinning clockwise.

It may not look well in the video but try it by actually making a Benham's top.

So, we show the youtube address in chat box later.

How does it look?

Can you see various color lines? This also differs from person to person, so there is no correct answer.

If you can, please tell me your vision with chat box.

3. Let's Enjoy illusions More.

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Part 1 - Benham's top - Let's spin it. **2. Spin it counterclockwise.**



Next movie shows the Benham's top spinning counterclockwise. How does it look?

Can you see various color lines?

3. Let's Enjoy illusions More.

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Part 1 - Benham's top - Let's spin it.



1. Spin it clockwise.
2. Spin it counterclockwise.

You can see various colors, and it depends on the conditions. This is also an illusion.

Maybe, You can see various colors, and it just depends on the conditions. This is also an illusion.

There are still many unknown elements about why this illusion occurs.

So, the illusion is difficult to see with online.

Well, I'm going to next part.

3. Let's Enjoy illusions More.

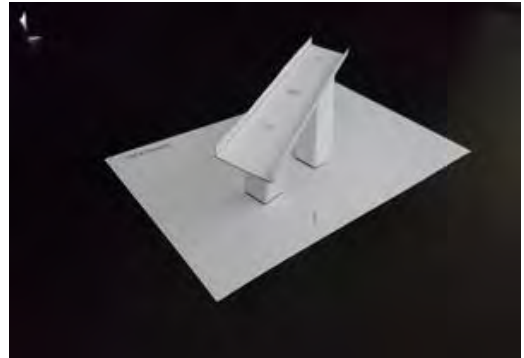
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Part 2. Let's Build a Strange Slope.

(i) Let's build a strange slope.

(ii) Let's take a look.

(iii) Let's play with it.

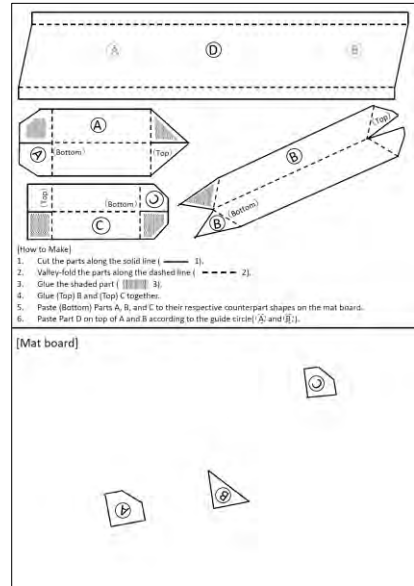
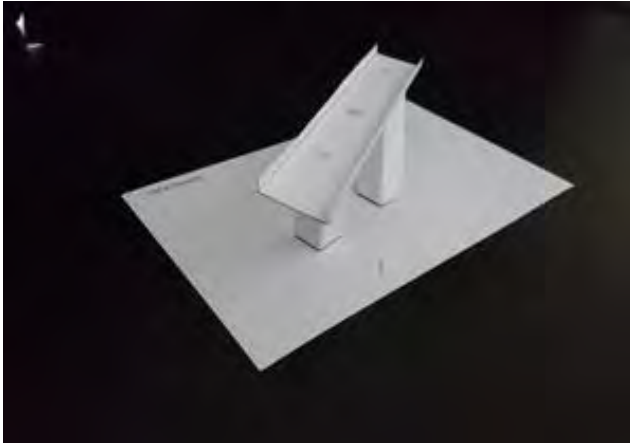


Part 2: I would like to introduce the “strange slope” .
Here is the agenda of this part.

It is a model that looks like an upward slope from front to back.

3. Let's Enjoy illusions More.

2-(i) Let's build a strange slope.



First, let's build a strange slope. I explain the way of building a strange slope. These are strange slope and pattern paper. We make a strange slope from the pattern paper. It takes 20 to 40 minutes to start from the beginning, or from cutting the pattern paper, so please take it home and try it. Today, I'm going to give you a rough idea of how to make the parts and make a strange slope, as shown in the photo on the left.

3. Let's Enjoy illusions More.

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2-(i) Let's build a strange slope.



THE MOVIE HOW TO BUILD A "STRANGE" SLOPE.

Now, allow me to show the movie how to build a strange slope.

Unfortunately, this video is very fast. Maybe you cannot make the slope together.

So, please take it home and try it.

Procedure (1) Separate the parts portion from the mat board of the pattern paper and cut the parts along the solid line. Remember to make a cut in each of Parts (A) and (C).

Procedure (2) Trace the dotted line with a ballpoint pen. This makes it easier to fold.

Procedure (3) Now you've got four parts.

Procedure (4) Valley-fold along the dotted line and glue the shaded part to make something resembling a pillar.

Procedure (5) Now you've completed four parts.

Procedure (6) Paste Part (A) so that it fits the shape of (A) on the base.

Procedure (7) Glue the parts of (B) and (C).

Procedure (8) Paste Part (B) so that it fits the shape of (B) on the base.

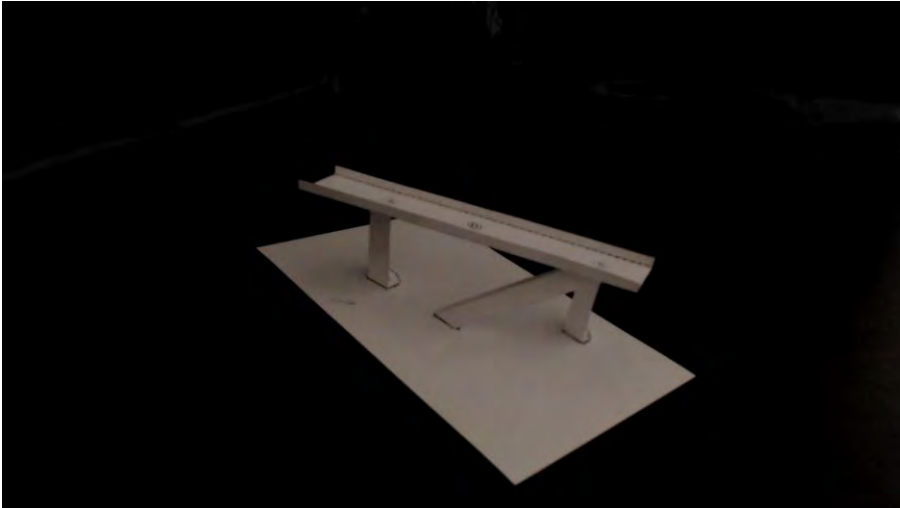
Procedure (9) Paste Part (C) so that it fits the shape of (C) on the base.

Procedure (10) Glue the upper part of (A) and (B+C) and attach Part (D) according to the guide circle (A and B)

3. Let's Enjoy illusions More.

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2-(ii) Let's take a look.



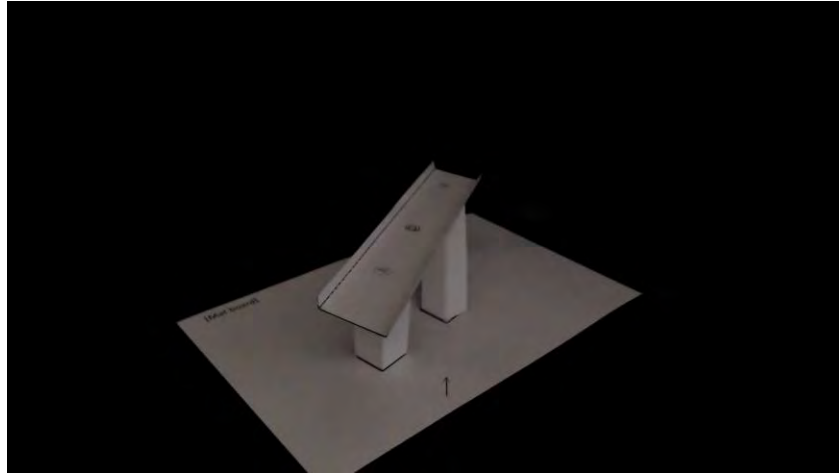
Next, let's take a look. Then, look at the assembly with one eye.
we have to find the best visual point to see upward from front to back.

Please look at this movie. Let's start.
I turn it counterclockwise.
Do you see upward from front to back ?

3. Let's Enjoy illusions More.

2-(iii) Let's play with It.

- Let's roll a marble.
- Let's take a video of the situation.



Finally, let's play with it.

Then, let's place and release a marble on the front side.

Do you see the marble moving up the slope? This is Strange Slope !!

If possible, let's take videos with a smartphone camera in cooperation with the people nearby.

4. Summary

- (1) Did you discover that an illusion is a brain trick?
- (2) Did you discover that illusions are actively used in life onboard the ISS?
- (3) Did you discover that there are many illusions around you?

Check out more illusions!!

Now, time is running out, so I will summarize today's presentation.

1st Did you discover that an illusion is a brain trick?

2nd Did you discover that illusions are actively used in life onboard the ISS?

3rd Did you discover that there are many illusions around you?

Check out more illusions!

OK, Let's call it a day.

References and reference sites

- JAXA Japan Aerospace Exploration Agency <https://www.jaxa.jp/>
- JAXA Digital Archives Material Provision Service
<http://jda.jaxa.jp/service.php>
- Experiment Commentaries, National Assembly,
Youngsters' Science Festival 2017
- High School Textbook Science and Human Life (Keirinkan)

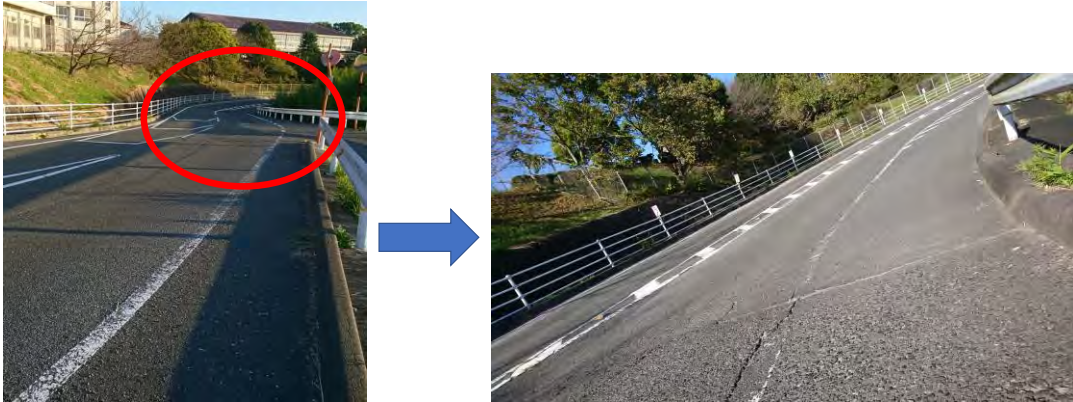
Here are the references for this presentation.

URL of the videos used in this material

- No.19 Benham's top (spinning clockwise) <https://youtu.be/EBZ96d1N-7g>
- No.20 Benham's top (spinning counterclockwise) <https://youtu.be/vt82YPpNTB4>
- No.24 How to make the strange slope https://youtu.be/UFLPIIPT5_o
- No.25 How to find the direction in which a marble appears to go up the slope
<https://youtu.be/0vWjWjbPWGA>
- No.26 Rolling a marble <https://youtu.be/watch?v=3GU5qV-HKhg>

Here are the references for this presentation.

Bonus photo



This is bonus photo.

Actually, it's a downward slope like the picture on the left.

When you look at the red part from a different angle, it looks like an upward slope.

You may see it as an upward slope.... It's an illusion.

There is this slope near our school.

Thank you for today.

See you again!!

Thank you for today.
See you again!!

That's all my presentation. Thank you very much for your kind attention. Now, we are going to next presentation. The presenter is Miki Kubota. Miki Kubota, are you ready? (if OK) Please go ahead!

The World of Illusion

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● About Illusion



© JAXA/SELENE

- How do Photo A and Photo B appear to you? Isn't it a mountain that you see for Photo A and a valley for Photo B?
- Just turn this sheet of paper upside down.
⇒ Now this is the **illusion**.

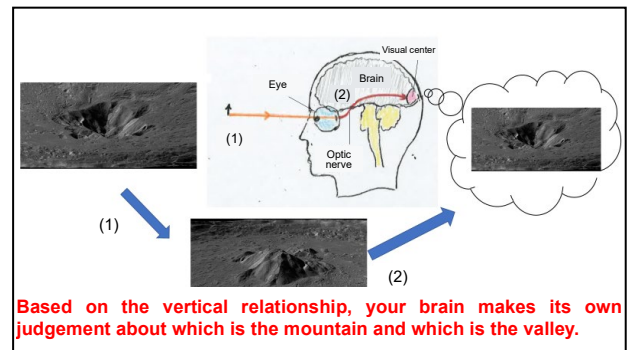
Experience, Physical Condition, Preconception.....



Remember these words.

Your brain processes the information on its own.

..... That is the illusion.



● In space, they make effective use of that illusion.

2. Space and Illusion Submitted to SEEC on Dec. 19, 2021

Environment of the International Space Station (ISS)


- The atmospheric pressure is almost one.
- Temperature
- Humidity

} The interior is comfortably controlled at all times.


• **The apparent gravity is very small.**

Environment outside the ISS


- No air
- The temperature is -454~+266F(-270~+130°C)
- Atmospheric pressure is zero.
- The sunlight and cosmic radiation are extremely powerful.




Astronaut Hoshide performing EVA



One-person American football



Fresh food and astronaut



Plant experiment device

©JAXA/NASA

2. Space and Illusion Submitted to SEEC on Dec. 19, 2021

- **The apparent gravity is very small.**

↓

- **There is no reference for top, bottom, left or right.....**

★ This causes great confusion!!





Inside Crew Dragon © JAXA/NASA

Now.....

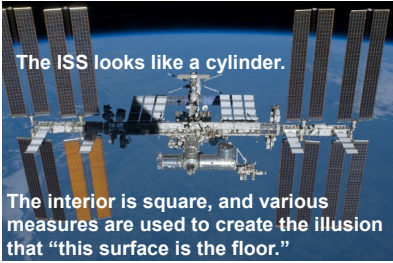
The environment is always kept comfortable inside the International Space Station (ISS). However, the apparent gravity (that you feel) cannot be controlled or is very weak, and when the shape is cylindrical, great confusion occurs, as shown in the right photo, as there is no vertical or horizontal reference.

Now.....

Certain measures are taken to alleviate this confusion. For example, the living quarters are square, lights and decorations are provided on the upper surface, and blue lines are drawn on the lower surface or side surface so as to make occupants see an illusion that "This surface is the floor."

In other words, this is an effective use of illusions.


The ISS looks like a cylinder.



The interior is square, and various measures are used to create the illusion that "this surface is the floor."

©JAXA/NASA

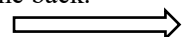
In other words, this is an effective use of illusions.



● Our presentation

1. What is an Illusion? 2. Illusion and Space 3. Let's Feel Illusions More.
(3-1. Benham's top 3-2. Let's build a Strange Slope) 4. Summary

A detailed explanation of handcraft is provided on the back.



● **Let's Build a Strange Slope.**

This is a photo of a completed slope. Does it look like it's going up from the front to the back? When you put a marble in front....

Let's make it and do it ourselves!!

☆ **Things you need**

Paper pattern, glue, scissors, ruler, and ballpoint pen.

* Instead of glue, double-sided tape will do.

☆ **Procedure**

- Making the Parts -

Procedure (1) Separate the parts portion from the mat board of the pattern paper and cut the parts along the solid line. Remember to make a cut in each of Parts (A) to (C).

Procedure (2) Trace the dotted line with a ballpoint pen. This makes it easier to fold.

Procedure (3) Now you've got four parts.

Procedure (4) Valley-fold along the dotted line and glue the shaded part to make something resembling a pillar.

Procedure (5) Now you've completed your parts.

- Assembly -

Procedure (6) Paste Part (A) so that it fits the shape of (A) on the base.

Procedure (7) Glue the parts of (B) and (C).

Procedure (8) Paste Part (B) so that it fits the shape of (B) on the base.

Procedure (9) Paste Part (C) so that it fits the shape of (C) on the base.

Procedure (10) Glue the upper part of (A) and (B+C) and attach Part (D) according to the guide circle (Ⓐ and Ⓑ).

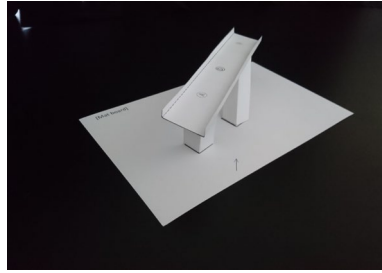
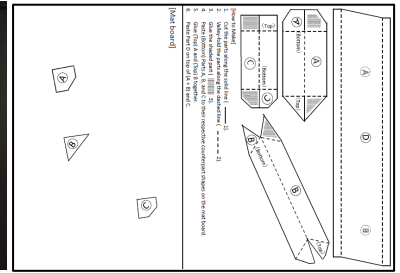
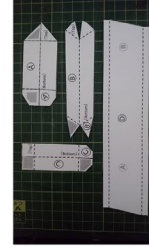
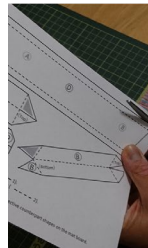


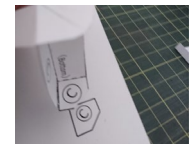
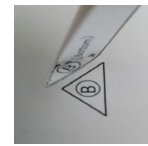
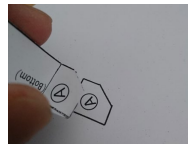
Photo of a completed slope



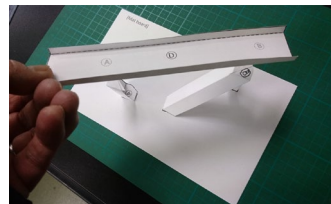
Pattern paper



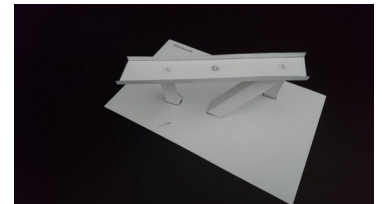
Procedure (1) Procedure (2) Procedure (3) Procedure (4) Procedure (5)



Procedure (6) Procedure (7) Procedure (8) Procedure (9)



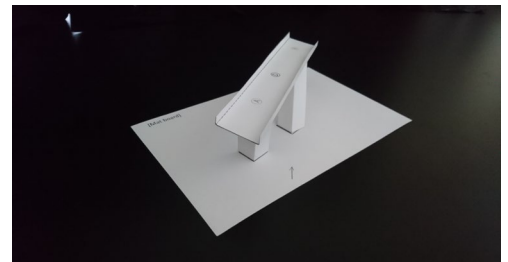
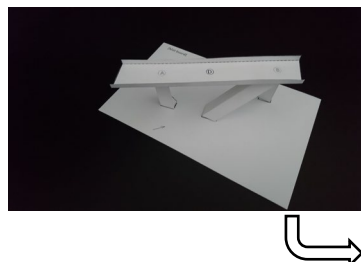
Procedure (10)



It's completed.

☆ **Let's give it a try!**

I. Look at the assembly with one eye and look for a viewpoint where Pillars (A) and (B) appear to be standing perpendicular to the floor, as in the right figure. Use the arrow as a guide. Then, Pillar (C) disappears as it is hidden behind Pillar B. It looks like the slide moves upward from (A) to (B).

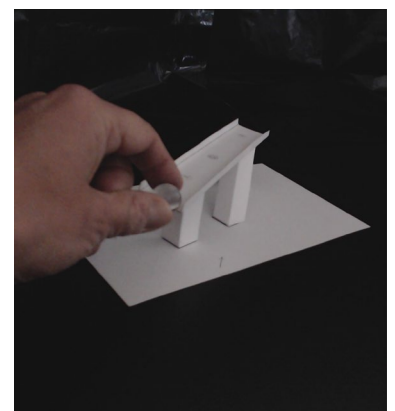


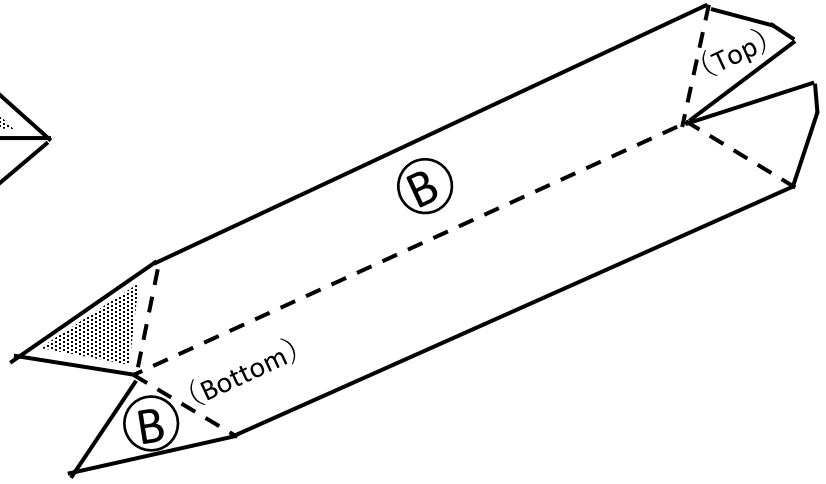
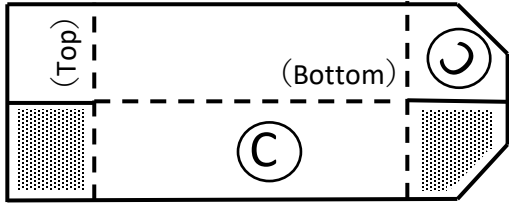
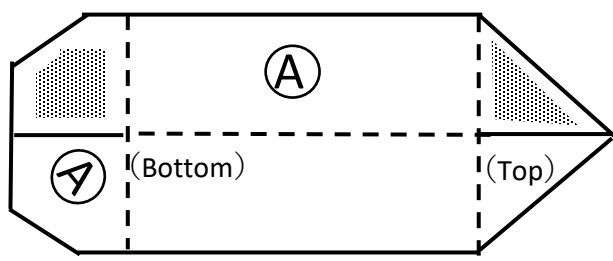
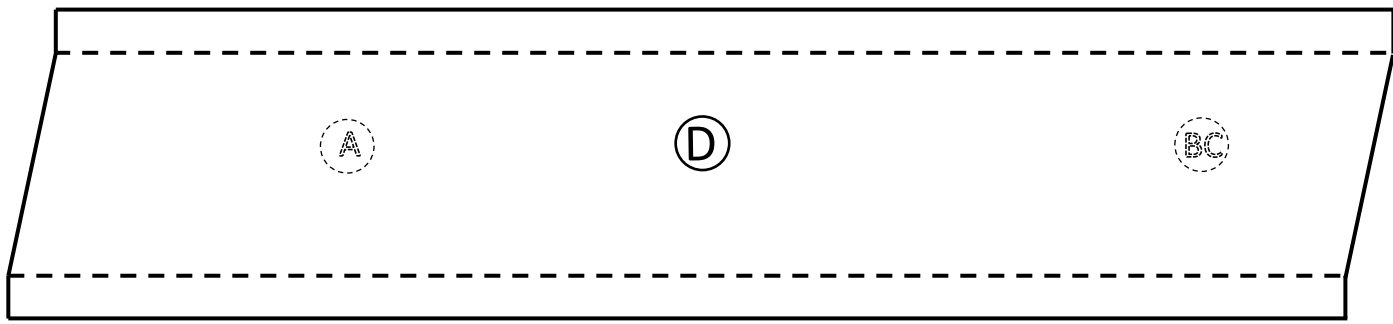
II. Let's place and release a marble on the (A) side

III. Take a video of how the marble rolls with a smartphone. If your smartphone has many lenses, it would be better to hide the bottom lenses.

● **References**

- Experiment Commentaries, National Assembly, Youngsters' Science Festival 2017
- JAXA Japan Aerospace Exploration Agency <https://www.jaxa.jp/>
- JAXA Digital Archives Material Provision Service <http://jda.jaxa.jp/service.php>





[How to Make]

1. Cut the parts along the solid line (——— 1).
2. Valley-fold the parts along the dashed line (- - - - 2).
3. Glue the shaded part (■■■■■ 3).
4. Glue (Top) B and (Top) C together.
5. Paste (Bottom) Parts A, B, and C to their respective counterpart shapes on the mat board.
6. Paste Part D on top of A and B according to the guide circle (Ⓐ) and (ⒷC).

[Mat board]

