Welcome to Zero-Gravity

Hideo SHIBATA
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TOKYO, JAPAN
日本海
東シナ海
台湾
日本
小笠原諸島

TOKYO JAPAN

TOKYO

JAPAN

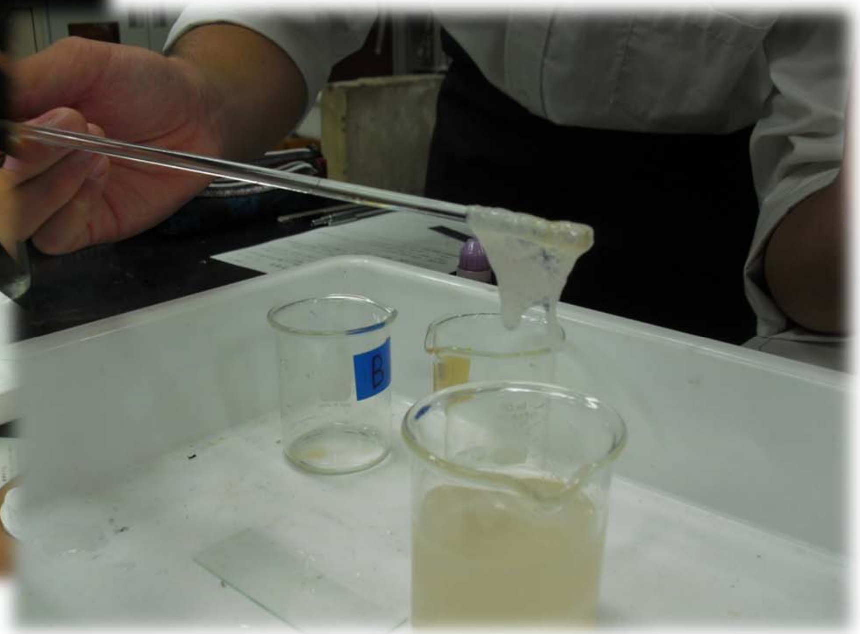
Kokubunji City

Japan's Birthplace for Space Development

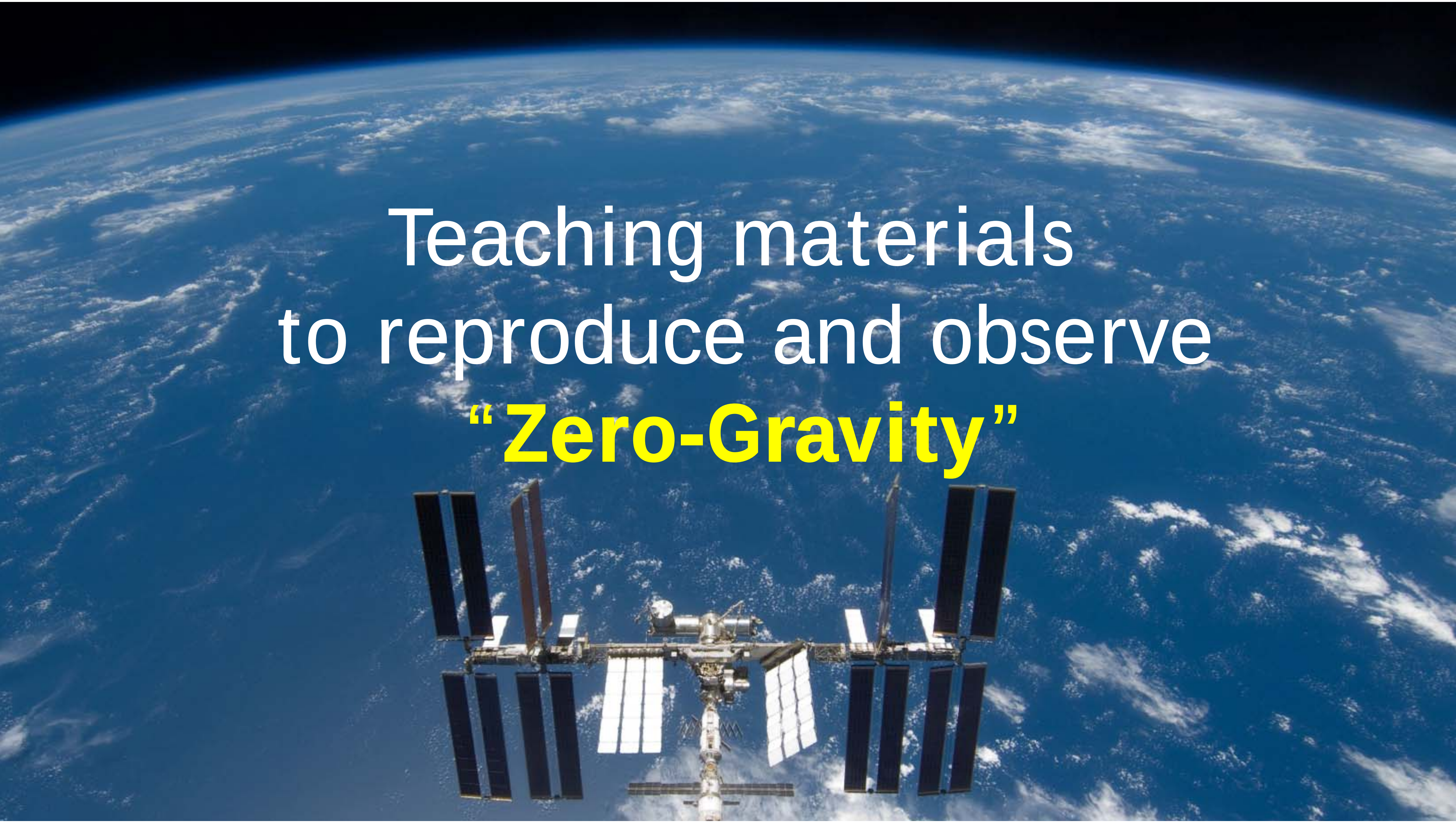
Kokubunji 3rd Junior High School

School Campus

Science Experiments

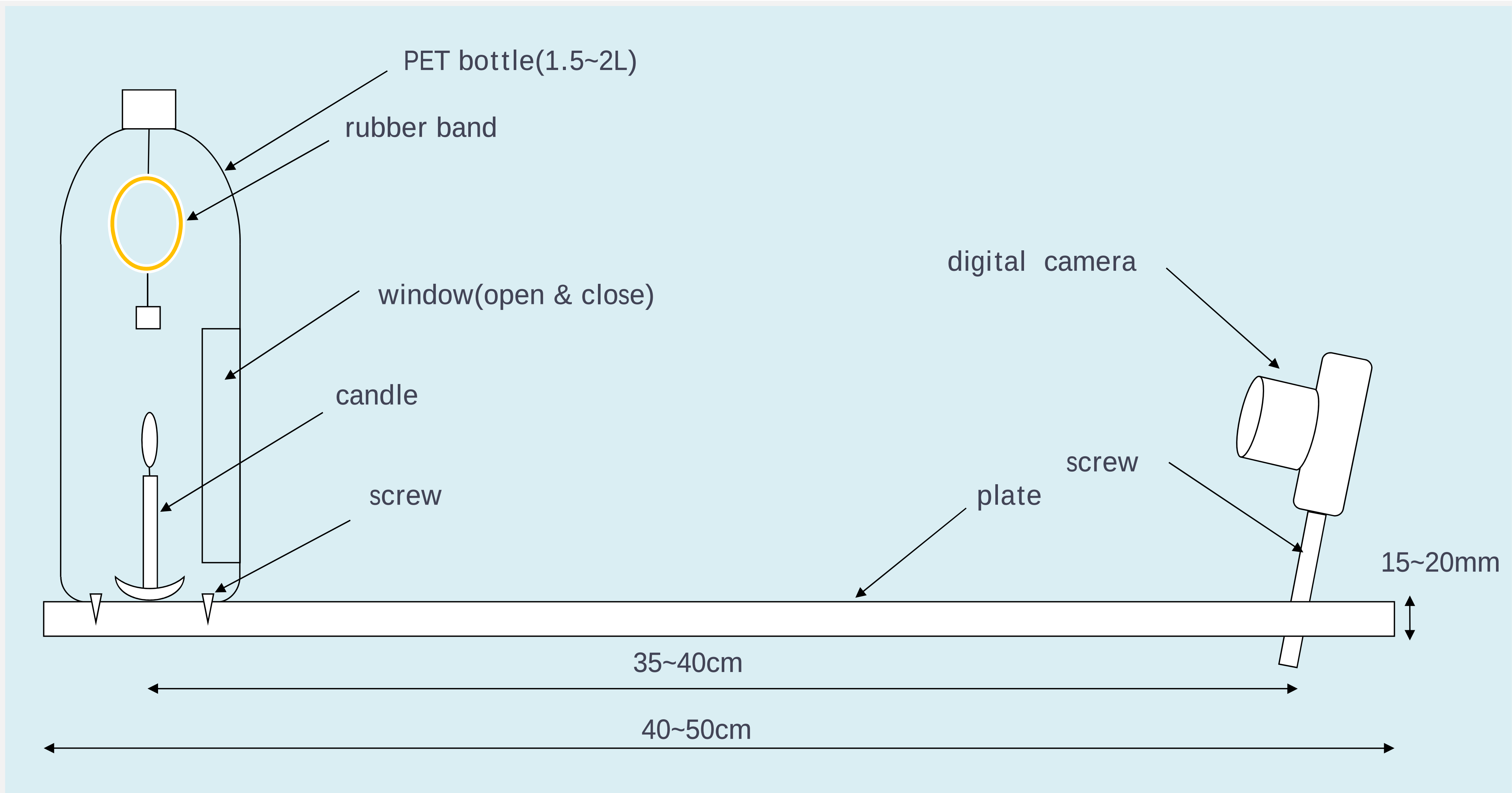


Choir Concert


Teaching materials
to reproduce and observe
"Zero-Gravity"

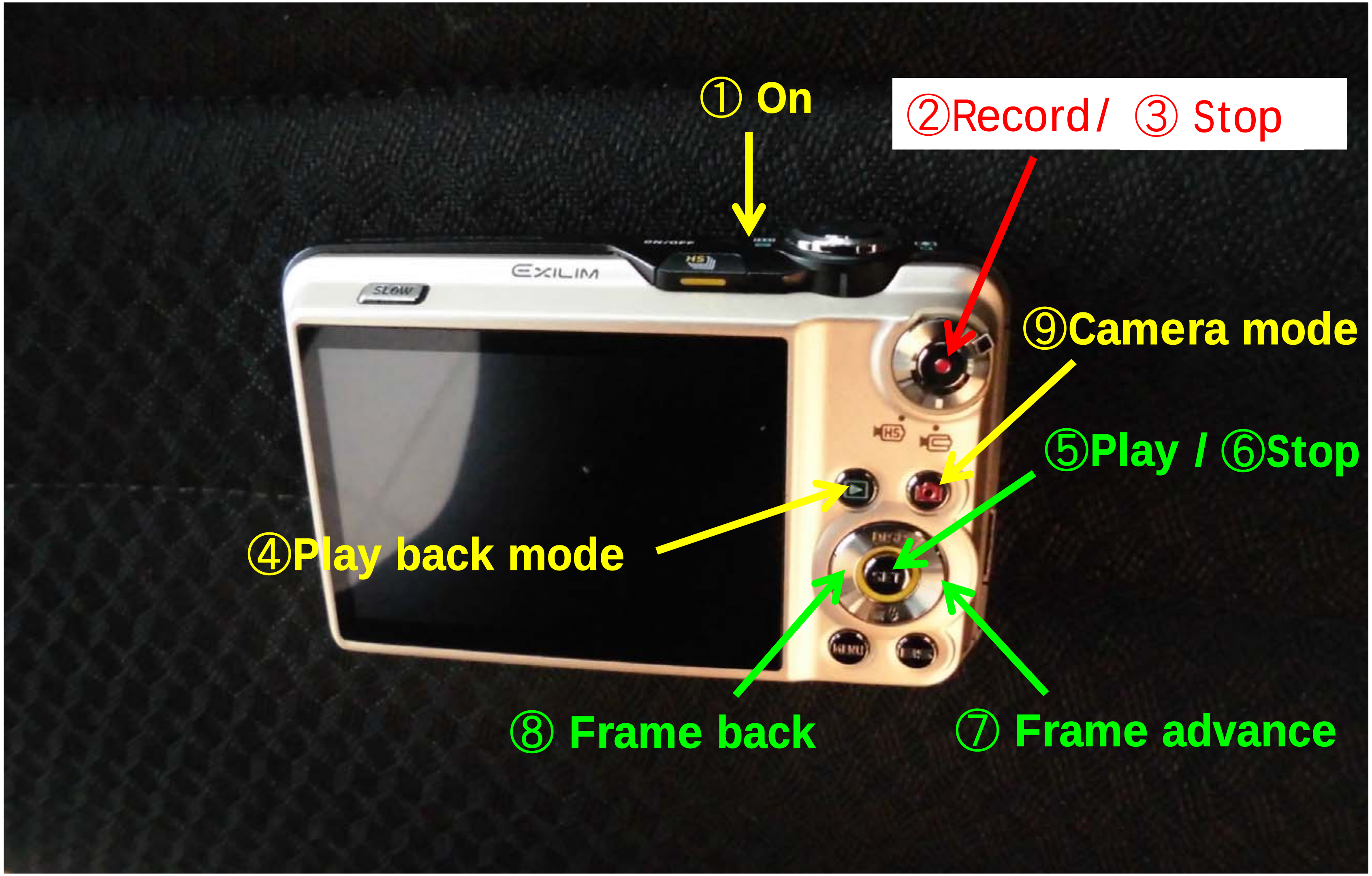
Experiment Materials

(1) Rubber band (2) Spring (3) Candle



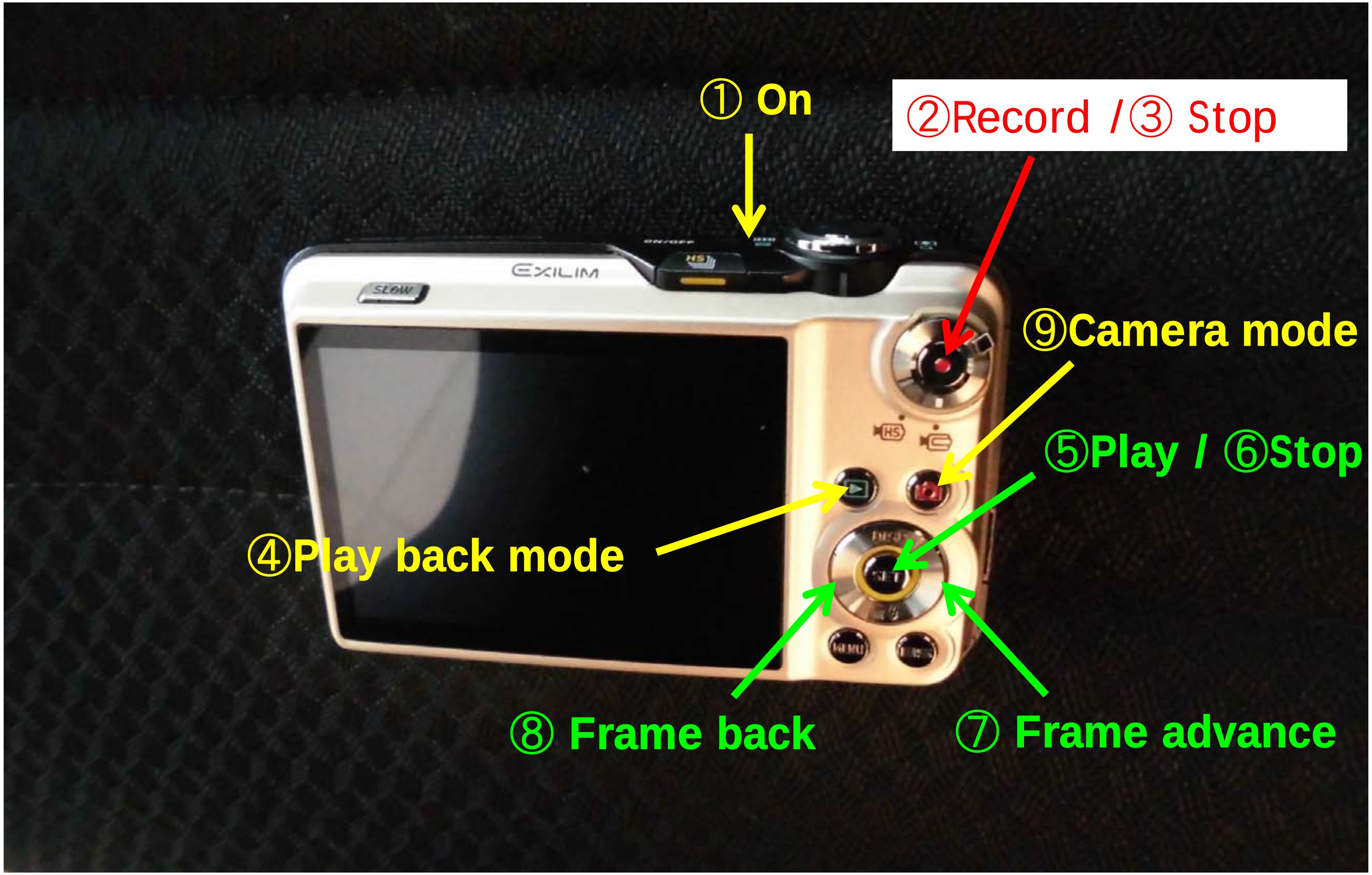
PET bottle(1.5~2L)
rubber band
window(open & close)
candle
screw
digital camera
screw
plate
15~20mm
35~40cm
40~50cm

What will happen to the shape of these rubber bands?



① On
②Record / ③ Stop
⑨Camera mode
⑤Play / ⑥Stop
④Play back mode
⑧ Frame back
⑦ Frame advance
EXILIM
SLOW

How about this spring?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⑤Play / ⑥Stop
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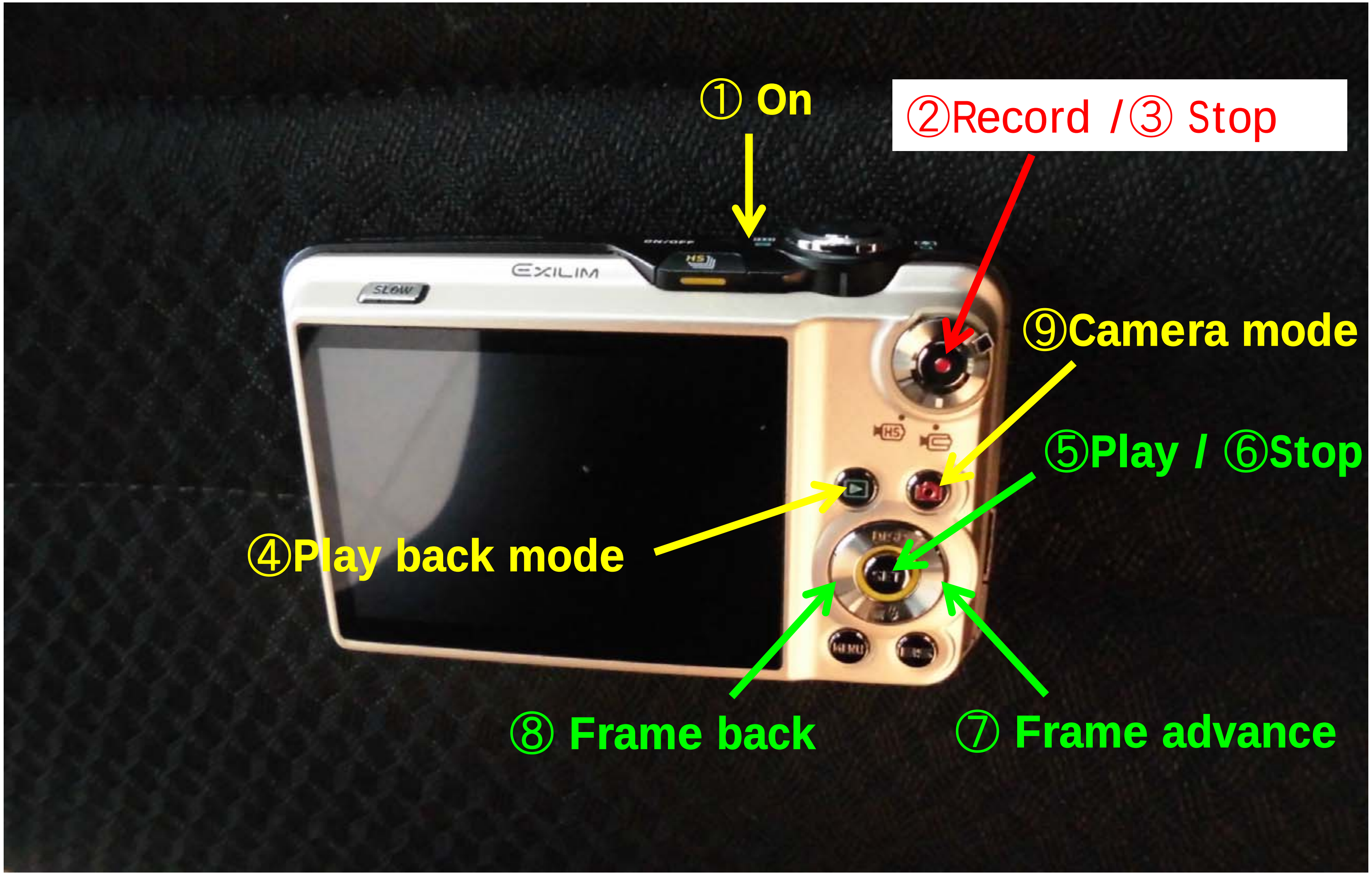
⑧ Frame back
⑦ Frame advance

This flame?



① On
②Record /③ Stop
⑨Camera mode
⑤Play / ⑥Stop
④Play back mode
⑧ Frame back
⑦ Frame advance
EXILIM

“Zero-Gravity Experiments”

can be carried out

even in normal classrooms

without using large-scale equipment

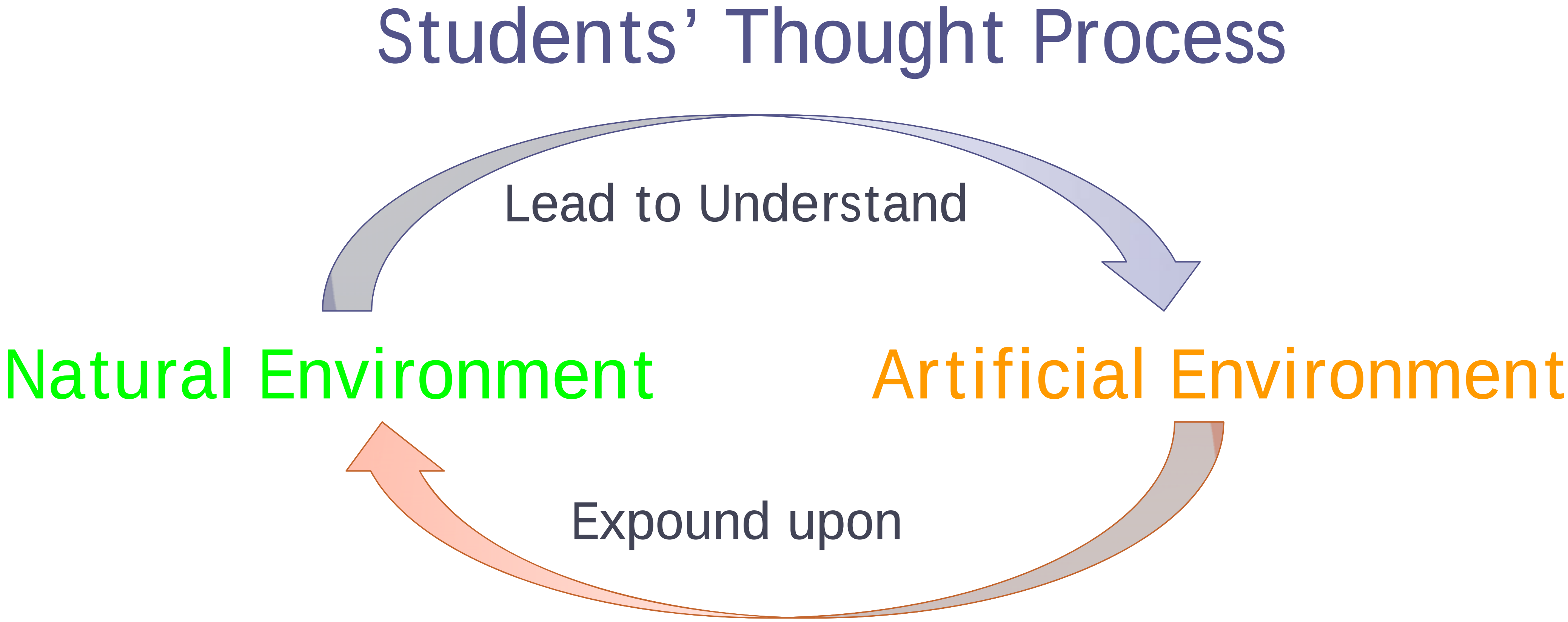
Benefits of the equipment;

Plastic bottle removes wind factor

Digital camera help us visualize

Birds/Jellyfish

My purpose in teaching



THANK YOU

Hideo SHIBATA
Kokubunji 3rd Junior High School
TOKYO, JAPAN

Hopes for Zero Gravity (0G)

Hideo Shibata
Senior Teacher
Kokubunji 3rd Junior High School
Tokyo, Japan

Hello. My name is Hideo Shibata and I am from Tokyo, Japan.
I feel greatly honored to be able to speak to you here today.

To begin , I would like to introduce you to Tokyo and the school where I work.

Tokyo is the largest city in Japan.
Tokyo has a very long history, and as Tokyo became the capital of Japan around 400 years ago, it has developed greatly as a center of culture, politics, finance and industry.

As some of you may know, the Olympic and Paralympic games will be held in Tokyo in 2020.

The school where I work is in a place called Kokubunji, which is in the suburbs of Tokyo.
Kokubunji also has a very long history: around 1,300 years ago, during the Nara period, a large temple (the Buddhist temple of Kokubunji) was built there by the central government at that time as a base for its management of the region, and the temple is still there today.

Kokubunji is also famous for being the starting point of Japan's space development.
In 1955, about 60 years ago, the first rocket launch in Japan was carried out in Kokubunji.
This was a very small rocket called a "pencil rocket", but it was Japan's first rocket used for scientific research. Hideo Itokawa and his colleagues from the Institute of Industrial Science at the University of Tokyo started Japan's space development, and this was commemorated in December of last year by the naming of an asteroid that circles in the solar system as "Kokubunji".
I feel very privileged to be able to give this presentation at SEEC today, and as a science teacher at a junior high school in Kokubunji I feel a special connection with all of you.

Kokubunji 3rd Junior High School can be found in the corner of Kokubunji City. It is a

standard-sized Japanese junior high school, with around 450 students aged between 13 and 15 years old.
These are students at work in one of my classes. They are extracting DNA from a banana in the laboratory. They are just about to extract the DNA with a stick.

The students are filled with enthusiasm in their studies, and our school also puts on many events such as athletic festivals and choral singing festivals.
In wintertime, skiing classes are held in the highlands of Nagano Prefecture (where the Winter Olympics were held), and there are school trips to the ancient capitals of Kyoto and Nara.

I use various materials to teach about space in science education at our junior high school. For example, today I would like to tell you about teaching materials where you can reproduce conditions similar to zero-gravity in the classroom on earth and the phenomena that occur under such conditions can be closely observed, as well as the ways of incorporating this into the curriculum.

As you are aware, gravity has an effect on all things that are on the earth. However, we become unable to sense gravity while falling. For a moment at least, we can reproduce conditions similar to zero-gravity by freely dropping items in the classroom. Today, using this method, I would like us to look at and experience together actual zero-gravity phenomena using rubber bands, springs, candles, and other items.

Having said that, even if we drop objects in this room, it will be difficult to see the falling action with the naked eye. It is impossible to see, because objects fall in such a short time. For that reason, I have come up with a method where a digital camera is attached to the equipment that will fall freely to video the drop, which will enable us to observe the drop by playing back the video. This is the equipment.
A plastic bottle is fixed to one end of a piece of rectangular wood, and a rubber band or spring is installed inside the bottle. A digital camera is then attached to the other end of the wood. The plastic bottle blocks the airflow when it falls. In other words, it is used to make sure that there is no wind factor. Please have a look at the simple diagram I will hand out.
The experiment method is simple. We place the object to be observed inside the plastic bottle, start the video recording, and make the entire piece of equipment drop onto a cushion. The phenomenon is momentary, but the camera should be able to record it accurately. OK, to begin with, let’s try this with a rubber band.

Experiment 1 – Instructions

(1) Attach a rubber band and a weight to the cap of the plastic bottle and secure it in place.
(2) Start the video recording and hold the equipment directly above a cushion.
(3) Let go and freely drop the equipment.
(4) Stop the recording and play back the video.

How was it?

You should have been able to see how the rubber band, which was stretched by gravity, momentarily returned to its original form.

Next, let's try it with a spring.

Experiment 2 – Instructions

(1) Attach a spring and a weight to the cap of the plastic bottle and secure it in place.
(2) Start the video recording and hold the equipment directly above a cushion.
    *At this time, if you hold the camera side of the equipment, the spring's vibration will stop quicker.
(3) Let go and freely drop the equipment.
(4) Stop the recording and play back the video.

How does it look?

You should have been able to see how the spring, which was stretched by gravity, momentarily returned to its original form.

Finally, we will use a candle.

I'm sure that many of you will have seen this in images released by NASA, but I would like us to observe what happens to the flame of a candle under zero-gravity conditions. Of course, here we are not inside the ISS. We are on the earth, where gravity has an effect on everything. But still, by using this equipment we can reproduce conditions that are similar to zero-gravity, and we can see what happens to the flame of a candle under such conditions. Let's see if we can get the same results as the NASA images!

Experiment 3 – Instructions

(1) Secure the cap on the plastic bottle.
(2) Open the side window and install the candle.
(3) Light the candle and shut the window.
(4) Start the video recording and quickly hold the equipment directly above a cushion as high as possible.
(5) Let go and freely drop the equipment.

(6) Stop the recording and play back the video.

How did it go?

Although it's only momentary, you should have been able to observe "zero-gravity conditions" just like we would experience inside the ISS.

These are the teaching materials I have proposed today, which let us reproduce and observe zero-gravity conditions on the earth. Now, as we have been able to confirm, I think it is excellent that we can carry out these experiments simply even in normal classrooms without using large-scale equipment. The fact that the plastic bottle removes the effects of the wind and the use of digital cameras help us visualize these effects are nice touches to the equipment. The materials used can be obtained at reasonable prices anywhere – not just in Japan – so please try this out.

Finally, let's turn our focus toward the natural world. This shows a bird's feet during flight. You can see its toes are open because they are free of its body weight, unlike when the bird is sitting on a branch. Likewise, a jellyfish in water keeps its tentacles loosely extended like this, because its floating power is effecting it.

These are not exactly zero-gravity, but I think the phenomena are linked. I take care not only to guide the thinking of students from natural environments such as space through to artificial phenomena in the laboratory, but also to construct lessons in such a way that ensures a flow where things from the laboratory are then returned and extended to natural phenomena. Today, we have together considered ways of incorporating space into lessons while viewing and visually experiencing it from the perspective of "zero-gravity".

I hope that this modest suggestion will be of some use to you all in your science lessons. I wish you all the best in your future activities.

Thank you very much for listening to my proposal today regarding "lessons incorporating space".

I hope you will take something away with you from this proposal. You are all most welcome to visit Kokubunji City and Kokubunji 3rd Junior High School.