ICEC NEWSLETTER

ON PHYSICS EDUCATION

INTERNATIONAL COMMUNICATION
EXCHANGE CENTER

Published by the Physics Education Society of Japan

Number 8 August

2001

Revised Version

Contents

The Second Japan-China Symposium on Physics Experiment Education in Universities Was Held in August 2000

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The Second Japan-China Symposium on Physics Experiment Education in Universities (ICEC Newsletters 2000) was held in August 2000 in Tokyo. About 130 physics professors and teachers (30 from China, 1 from the Czech Republic, 1 from Germany and 97 from Japan) came together to discuss new courses of physics laboratories in universities, new teaching materials in the basic physics laboratory, hands-on experiments, use of computer and computer network in the laboratory, etc. The seventy-four papers presented in the symposium are significant for the progress of the basic physics education in universities and colleges. Besides the discussion in the sessions, active exchange of useful information was made during the breaks and other times. The symposium undoubtedly promoted friendly relations among all the participants. The Proceedings were published by the Physics Education Society of Japan. It is available from the Symposium Secretary (e-mail address: kobayash@rs.kagu.sut.ac.jp). The next symposium will be held in China in early September of 2002.

From YPC News Letter
New Cartesian diver

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A child's toy called a "Cartesian diver", which illustrates the principles of floatation, is well known. A barely floating "diver" in a sealed plastic soft drink bottle can be made to sink by applying a small amount of outside pressure to the bottle. The "diver" is made from a small container, commonly is used to hold sauce in a lunch box.

Recently, our YPC members, Ichie et al. (1) devised a diver which rotates when it sinks or rises. They made two holes in two opposite lower sides of the diver obliquely, through which water can flow in or out as the pressure is increased or decreased. Different amounts of water can be displaced in the diver by squeezing and releasing the bottle, thus changing it back and forth from a sinker or a floater (Fig.1).

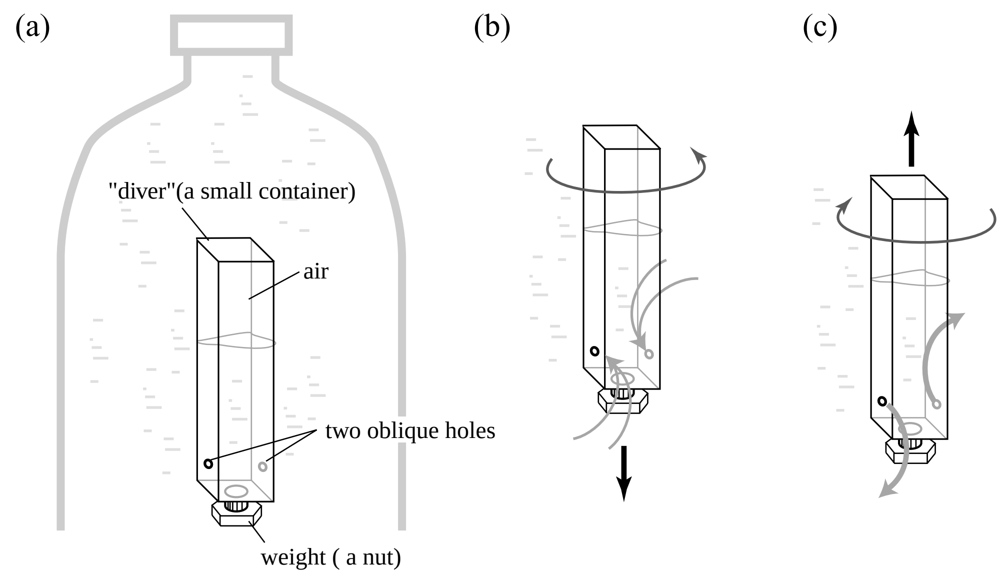

Fig.1: (a) soft drink bottle filled with water (b) The diver sinks while sucking in water. It rotates in the opposite direction. (c) The diver rises while spewing out water. It rotates in the normal direction.

The diver devised is just like Feynman's inverse lawn sprinkler (2,3) or a normal sprinkler. When the diver rises while spewing out water, it rotates in the normal direction. If you squeeze the bottle, water is sucked into the diver. Then the diver sinks while rotating in the opposite direction to the normal lawn sprinkler, like Feynman's inverse lawn sprinkler.

When Ichie showed this experiment to his students at Kamakura-Gakuen High School, a bright idea occurred to them. They applied this device to a fishing game. They attached a hook to the diver in order to lift fish, made from small containers, that are barely sinking. It is difficult to hook the fish because of the rotation of the diver (Fig.2). We were all deeply impressed by their great creative powers.

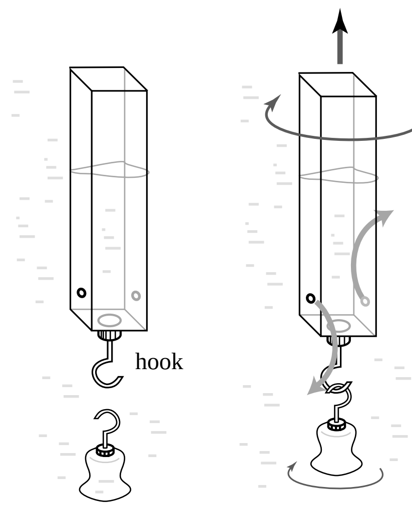

Fig.2: Fishing game devised by students

References

(1) YPC News Letter, No.150 (2000), No.152 (2000), No.157 (2001), No.159 (2001), in Japanese.

(2) R.P.Feynman, "Surely You're Joking Mr. Feynman", Bantam Books, 1989

(3) Robert Ehrlich, "Why Toast Lands Jelly-Side Down", Princeton University Press, 1997

THE UTILIZATION OF SNOWFALL

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Hokkaido Island is located in the north part of Japan. It is cold and has much snowfall in winter even though its latitude is not so high. The west part of Japan also has heavy snowfall because of seasonal winds that come from the west over the Japan Sea. The Japanese people are thus familiar with snow.

The 2000 annual meeting of The Japan Society of Applied Physics was held in September in Sapporo, the capital city of Hokkaido. The Division of Applied Physics Education organized a symposium. Four articles from speakers at this symposium are printed in the Japanese Journal of Applied Physics Education Vol.25 Number1 (2001). These authors and the titles are as follows:

Hiroshi Tabuchi: "The Four Seasons in Hokkaido and Finland"
Tomoko Ikeda-Fukazawa and Takeo Hondoh: "Crystal Physics of Antarctic Ice"
Yukie Kaneko and Zyukiti Yamagami: "Snow Utilizing Institution Introduced in Bibai City in 2000"
Masayoshi Kobiyama: "Preservation and Utilization of Snow"

I will review the last article – "Preservation and Utilization of Snow". As a cooling resource in summer, various methods for preserving the snow have been developed. Technique for utilizing snow have also been developed. For example, air conditioning of living space is made by the flow of water from melted snow. For cooling larger spaces, air that is forced to flow over the surface of preserved snow is used. It is also used for the preservation of agricultural products. Sometimes it can create suitable conditions for preservation (temperature 5 °C, humidity 70 % for rice). These techniques have been adopted widely in areas with heavy snowfall. The author gave a lecture on these techniques to schoolboys who lived in an area with heavy snowfall. The schoolboys knew that their families had been working hard to protect their living from heavy snowfall. The author intended the schoolboys to recognize the value of the heavy snowfall with the practical work of utilizing snow.

Figure 1 shows the structure of the device that the schoolboys made in his lecture. Figure 2 is a photograph of it. The structure is very simple. The three plastic baskets are placed one on tap of one another. The bottom

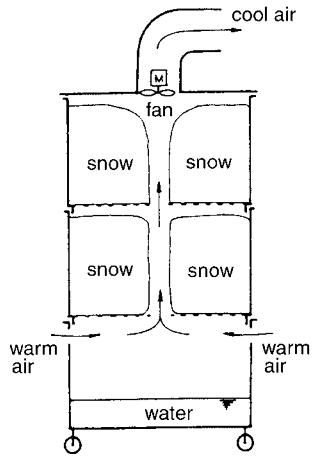

Fig.1

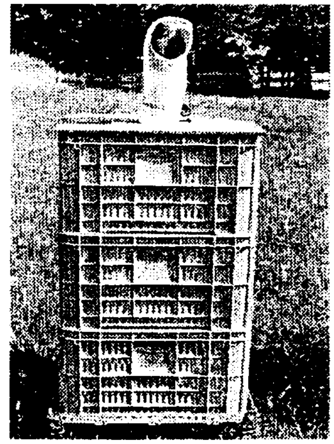

Fig.2

basket, attached with four casters, is used to collect the melted water. Snow was placed into the upper two baskets. Some holes were made through the snow to enable air to flow through it. The top of the baskets was covered with a plate. This top plate was attached with a fan and a guide tube. The fan was used to draw through air. Warm air was drawn in through the bottom basket and cool air was blown out from the guide tube on the top plate.

Teaching Air Pressure by Using Handmade Suckers

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1. Introduction

Although students have repeatedly learned about atmospheric pressure in chemistry, earth science, and physics classes in junior high school and high school, many of them have not got a true perception of it. Even some students who seem to understand atmospheric pressure tend to think of it as the weight of the air. So I have been looking for a suitable instrument which leads students to the right concept of atmospheric pressure.

When we teach atmospheric pressure, we refer to Torricelli's experiment and the Magdeburg hemispheres. But neither of these are simple to perform. These experiments have another drawback. They lead students to think that they are caused by attraction due to vacuum, rather than by the atmospheric pressure acting on them. It is very difficult to sweep away this misconception. There are some simple experiments such as a demonstration with a sucker and a demonstration with a cup filled with water, covered with a piece of cardboard and turned upside down. But intermolecular forces play an important role in these phenomena; it is hard to attribute them simply to atmospheric pressure.

I developed, four years ago, a new teaching material which shows the effect of the air molecules explicitly. I have shown it in my classes in chemistry, physics, and earth science. I received favorable reactions from students and good understanding. I also got favorable recognition from science teachers in a neighboring junior high school.

2. Assembly

The structure of the tool is very simple: a thick rubber sheet with a handle attached with screws and nuts. The sheet should be flat and have no holes, otherwise it does not work well due to air leaks. I have made two types: a standard type, which costs about \$8.00; and a simple type, which costs about \$2.00 (Fig.1). The former is suitable for a demonstration. The latter is suitable for students use. It depends on the budget!

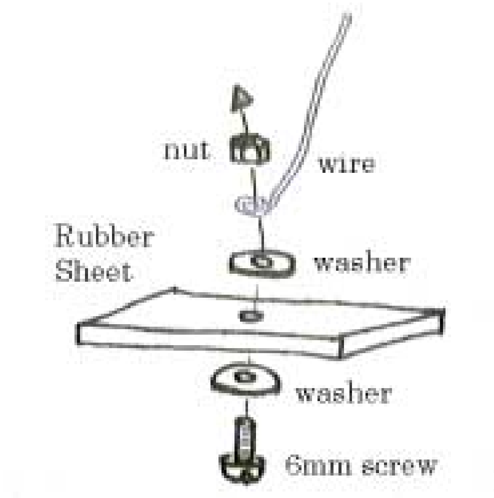

Fig.1

Materials

<Standard type>	a.	A rubber sheet (3 mm thick, 300×300 mm)
	b.	A plastic handle for luggage
	c.	Four sets of 6 mm screws and nuts
	d.	Four screw washers (8 mm bore, 20 mm diameter)
<Simple type>	a.	A rubber sheet (3 mm thick, 100×100 mm)
	b.	A thick metal wire, 10 – 20 cm long
	c.	One set of 6 mm screw and nut
	d.	Two screw washers (8 mm bore, 20 mm diameter)

According to my experience, 3 mm thick rubber sheet is the best for this experiment. A 1 mm thick rubber sheet does not work well. A 2 mm thick rubber sheet works, but not so effectively. Be sure to use big washers or the suck breaks easily.

3. Flow of Lesson

I formulated a lesson to make students realize that the collisions of molecules are the cause of atmospheric pressure, which produces a strong force.

The details of the lesson following the demonstration are different according to the course taken by the students. To those on the science course I teach the quantitative aspect of atmospheric pressure, which I do not teach to those on the culture course.

The procedure of the demonstration is as follows. First, I show students that the sucker is made of rubber and there is no secret in it. I put the handmade sucker on a desk, grab its handle and move it horizontally, showing that it moves rather freely. Then I pull it upward. The sucker does not leave the desk. I can even lift the desk with the sucker. When you use the standard one you can lift a heavy desk. Even the simple one can lift a light desk or a chair (see Fig.2). I explain that the atmospheric pressure presses the rubber and the desk. The fact that a desk can be lifted shows that the atmospheric pressure acts upward. I pass the handmade sucker around to let the students confirm the strong force.

Fig.2

Many students have been taught that the cause of atmospheric pressure is the weight of the air. However, they have since realized their misunderstanding through the fact that the central part of the sucker does not touch the desk and still can lift the desk. It means that the pressure also acts upward. How about vertical surfaces? You push the sucker onto the blackboard and you see how strong a force you need to pull it off. It shows that the pressure acts in all direction.

At the end of my lesson I tell the students that the collisions of the air molecules causes the atmospheric pressure, producing strong force. I teach them the magnitude of the force per cm^2. Then the students calculate the total force acting on the rubber sheet.

This tool is also suitable for teaching the principle of center of gravity. If you try to lift a desk with the handmade sucker placed off-center of the desk top, the sucker slips. When students fail to lift a desk, it is a good chance to teach the idea of center of gravity.

4. Students' Remarks

Here I reproduce some of my students' remarks after a physics (thermodynamics) class in 1999.

A: Does one kg-weight really act on $1\,\mathrm{cm}^2$? I can't believe it. I was surprised that atmospheric pressure always acts. Have we got accustomed to it? One kg-weight per one cm^2 is so light? How mysterious the human being is!

B: I was very impressed by the lifting of the desk by a flat rubber sheet. I reckon that the rubber sucker is made to work by letting out the air between the sucker and wall.

C: I realized that atmospheric pressure is produced by high speed molecules.

D: The pressure between the rubber sheet and the desk become weaker so a force acts on it to resist the atmospheric pressure.

E: I was surprised to know that a force of 9000 N acts on the rubber sheet. I have learned the unit of pressure $\mathrm{N/m}^2$ is called the Pascal.

F: I have realized that the collisions of the air molecules make it hard to lift the rubber sheet from the desk.

G: I now know the reason why the rubber plate couldn't be lifted. A force of 9000 N acts on the rubber sheet!

The students' remarks show that they realized how strong the atmospheric pressure is. The students have also understood that the rubber and the desk don't adhere to each other because the rubber moves horizontally very easily. Students B and D's remarks show that students still think that vacuum combines the two bodies. This idea is very difficult to sweep away. I deeply feel that a single teaching material cannot lead students to get the right idea. We have to improve the teaching of the concept of atmospheric pressure. I admit that my lesson could be improved in many respects. Nevertheless, I assure you that this equipment has a great impact on the students. I recommend that as many readers as possible make this sucker and exchange information to make a good teaching flow of atmospheric pressure. I would like to receive many responses from readers.

I would like to express my gratitude to the members of Yosenabe Physics Circle in Saitama for giving me the opportunity to talk about this subject and valuable comments.

(Translated by YUGUCHI Hidetoshi)

Abstracts of Selected Papers in the Journal of the Physics Education Society of Japan Vol.48, 2000

Selected by AONO Osamu (e-mail: greenfld@jichi.ac.jp)
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No.1 Making a Hydrometer Using a Straw by SAWADA Kazuhiro, FUSHIMI Tomoko and HAGIWARA Takeshi: J. Phys. Ed. Soc. Jpn. 48-1 (2000) 12-15.

A hydrometer was easily made using familiar materials. It can measure the density or specific gravity of almost all liquids for daily use. The range of measurements was made wide therefore the sensitivity or accuracy was rather poor compared with goods on the market. Measurements can be made using different conditions such as the total length, outer diameter and the number of weights. This hydrometer can be used as an effective instrument of education for combined study, on various forces acting on it, the plastic material itself and so on.

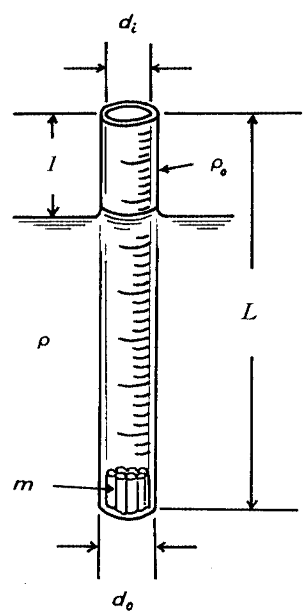

Fig.1: Floating hydrometer

No.2 Electrical Conductivity of Ordinary Water, as an Introduction to Experimental Physics. by OHNO Koki and TAKAKI Toshiaki: J. Phys. Ed. Soc. Jpn. 48-3 (2000) 220-223.

The electrical conductivities of samples of water collected at various places

Fig.2: The electrodes for measurement of electric conductivity

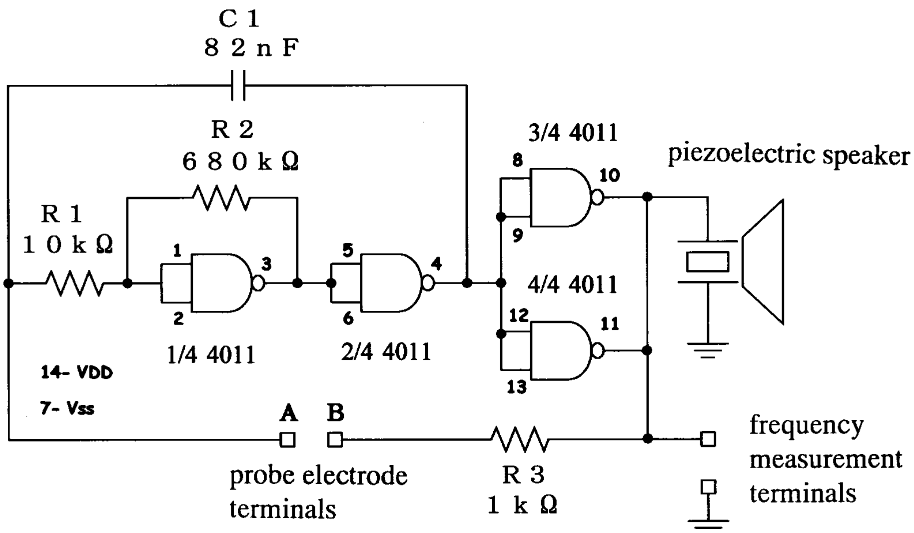

Fig.3: CMOS NAND gates oscillator

were measured as an assignment for the medical physics course. The assignment included assembling a circuit for measurement by soldering the components. The circuit made a sound, when the electrical current flowed through the water to be measured. The higher the conductivity the higher the frequency of the sound emitted. Students found that distilled water into which their fingers ware dipped was highly conductive.

No.3 Newcomen's Steam Engine Made of an Injector Syringe and a Flask by KAWAKAMI Akira: J. Phys. Ed. Soc. Jpn. 48-4 (2000) 315-316.

When steam is injected into the cylinder from boiling water in a flask, the piston moves outward. Then cold water jetted in the cylinder cools down and condenses the steam so that the piston draws back rapidly, showing the effect of atmospheric pressure. After draining the water and closing the drainpipe, the piston begins to move outward again. This process can be repeated any number of times.

Fig.4: Apparatus

Fig.5: Blowup of the cylinder connections

No.4 Behaviors of a Cartesian Diver and the Detection of the Volume Change of Glass Bottles by AONO Osamu: J. Phys. Ed. Soc. Jpn. 48-6 (2000) 515-516.

The equilibrium point between gravity and buoyancy on a cartesian diver is an unstable point. On the basis of this instability, minute volume changes were detected for various shaped glass bottles. In order to explain the behavior of the cartesian diver in the bottle, various concepts are need to be considered such as hydrostatic pressure, atmospheric pressure, surface tension, elasticity, plasticity, thermal expansion of water and glass, viscosity of water.

Announcement of the UK – Japan Symposium and Workshop on Physics Education – Advancing Physics Project

Tae RYU

1-14-2-118, Minamiooi, Shinagawa, Tokyo 140-0013

On the IoP Advancing Physics Project, the Workshop, Symposium and Open Classes will be held in Japan from 20 to 27 August 2001, just after the 2001 International Conference on Physics Education in Cultural Contexts in Korea. Information of the meetings is following:

1. Symposium on Physics Education–Advancing Physics Project

Date: August 20 (Monday) 13:30–16:30, 2001

Place: Graduate School of Arts and Science, University of Tokyo

Attendants: About 100 physics teachers mainly from high schools and universities in Japan.

Program:

- 13:30 Opening: Prof. R. Lang (Tokyo University of Agriculture and Engineering, Chairman of the Committee on Physics Education of the Science Council of Japan)
- 13:40 Lecture: Prof. Jon Ogborn (Institute of Physics U. K., Director of the Advancing Physics Project team)
  "How IoP has developed the Advancing Physics Project"
- 14:40 Tea Break
- 15:00 Discussion
- 16:30 Closing

Organization: The Physics Committee of the Science Council of Japan Supported by The Physical Society of Japan, The Physics Education Society of Japan and The Japan Society of Applied Physics

For further information on the symposium, please contact Prof. Toshio Hyodo (hyodo@phys.c.u-tokyo.ac.jp fax:81-3-5454-6519) of the University of Tokyo.

2. Workshop on Physics Education–Advancing Physics Project

Date: August 21 (Tue.) 13:30-20:30, August 22 (Wed.) 9:00–17:00, 2001

Place: Honjyo High School (attached to Waseda University)

Attendants: About 50 physics teachers mainly from high schools in Japan.

Themes:

- New contents for a new approach to physics education and new methods and tools in physics education–Advancing Physics.
- How teachers and science education researchers can contribute to the improvement of science education in schools by using the results of research in education.

Invited Speakers & Workshop Organizers:
Prof. Jon Ogborn (Institute of Physics,
Director of the Advancing Physics Project team)
Mr. Philip Britton (Leeds Grammar School,
Member of the Advancing Physics Project team)

Program:

August 21 (Tuesday) Opening, Plenary Lectures & Demonstration

13:30–13:40	Opening: Mr H. Yuguchi (Oomiya-Musashino High School)
13:40–15:00	Lecture & Discussion: Jon Ogborn & Philip Britton ‘Physics Education in Primary & Secondary Schools in the U.K.’
15:30–16:40	Lecture & Discussion: Ogborn ‘Developing Advancing Physics’
17:00–18:10	Lecture & Discussion: Britton ‘Teaching Advancing Physics’
18:30–19:30	Dinner
19:30–20:30	Demonstration by Japanese Teachers

August 22 (Wednesday) Workshops, Closing & Dinner Party

9:00- 9:30	Lecture: ‘Examination of Advancing Physics’
9:30-10:30	Workshop A: Communication
11:00-12:00	Workshop B: Designer Materials
13:30-14:30	Workshop C: Waves and Quantum Behaviour
15:00-16:00	Workshop D: Space and Time
16:00-16:50	Discussion
16:50-17:00	Closing
17:30-	Dinner Party

* In all sessions, translators will help participants.

Organization: Association for Physics Education in Japan Supported by: The Physics Education Society of Japan, The Physical Society of Japan, The Japanese Society of Applied Physics, The British Council

For further information on the symposium, please contact Tae Ryu (ktryu@mars.dti.ne.jp, fax: 81-3-3768-7642)

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