

## 発表1

### Study on Mathematics ~Probability~ 確率の関数化に迫る～高校数学の深層

We researched the probability of repeated trials in high school mathematics. At first, we started studying with the first question below.

~1st Question~

When dice are thrown  $x$  times, find the value of  $x$  when the probability of rolling a one three times is maximized. Solving the first question by functionalizing and by using formulas, we found that there are two values of  $x$  where the probability is maximum.

Next, we continued studying with the second question below.

~2nd Question~

When dice are thrown  $x$  times, find the value of  $x$  when the probability of (probability is  $t/s$ ) rolling a one  $m$  times is maximized. Solving the second question generally, we found that the values of  $x$  are  $(s/t)^* m$ ,  $\{(s/t)^* m\}-1$  when the value of  $(s/t)^* m$  is a natural number.

## 発表2

### Determining the Salinity of Soy Sauce Using the Mohr's Method and Buoyancy モール法・浮力から探る！～醤油の塩分濃度～

We wondered about the difference in salinity depending on the type of soy sauce. Therefore, experiments were conducted with the aim of producing a kit that can easily measure salinity. At first, the salinity of various soy sauces was investigated in the literature. The salt concentrations stated in our references were 16-17% for *Koikuchi* soy sauce, 18-19% for *Usukuchi* soy sauce, 17-18% for *Shiro* soy sauce, 12-14% for *Saishikomi* soy sauce, and 16-17% for *Tamari* soy sauce. Knowing that there is a difference in salinity depending on the type of soy sauce, we decided to conduct an experiment using Mohr's method. The result was that the error between the values obtained by using Mohr's method and the values stated in literature was large. After that, an experiment to verify the accuracy of the Mohr's method was done. The error for that experiment was small and the correct value was obtained. Therefore, we considered that the reason for the difference between the values in literature and our results was the composition of the salts contained in soy sauce. Re-calculating the results allowed us to approach the values shown in our references. Next, a small and practical salinity measurement kit which uses buoyancy was prepared. We found that that there is a proportional relationship between the salinity of a saline solution and the mass of the boiling stones added. However, if there is something other than salts in the solution to be examined, it is thought that an error will be obtained. Therefore, from now on, it is necessary to improve the kit and carry out trials so that it can be put into practical use.

### 発表3

#### Verification of Ionic Balance by pH Sensor ～Is it Really a Titration Curve ?～ pHセンサーによる検証～滴定曲線 本当にそうなるの？

The neutralization titration curve of the mixture of NaOH and Na<sub>2</sub>CO<sub>3</sub> does not consider the change of pH just after the titration start to be a neutralization point, and it is decided that it is in the neutralization titration curve of two phases of changes. However, explanation about this first step neutralization titration curve is vague and the reason why this first step neutralization titration curve isn't regarded as a neutralization point isn't described. We felt these contents to be suspicious and we really tested it and performed the study that we inspected. At first, as a result of having tested the neutralization titration of amino acids as a spare experiment to gather sample data necessary to make database software and a comparison of the experimental data, we knew that a neutral amino acid formed that a two-step neutralization titration curve, and an acidic amino acid formed three phases of neutralization titration curves. Our knowledge of neutralization titration and the ion equilibrium was deepened.

We prepared a mixed solution of NaOH and Na<sub>2</sub>CO<sub>3</sub>, titrated it with HCl, poured NaOH into a beaker, and left it exposed to the air for 7 days. We took it out every day. We titrated it with HCl and we watched for changes by over time.

We poured NaOH into a beaker and left it exposed to the air when that part became larger with the passage of time. Also, as time went by, the time taken before reaching the first stage got shorter.

### 発表4

#### The Relationship between the Growth of Sprouted Plants and the Partial Pressure of Carbon Dioxide 低圧化における発芽後の生長と二酸化炭素分圧の関係

Plans of emigration to Mars are now being devised by various countries and organizations around the world. However, one of the biggest problems is getting food on Mars. So we conducted our research using white radish sprouts in order to determine if the growth rate of the white radish sprouts would be affected by low pressure and the partial pressure of carbon dioxide. We conducted this research with the aim of cultivating plants on Mars. We hypothesized that the higher the partial pressure of carbon dioxide is, the more the white radish sprouts will grow. For our experiment, we kept the partial pressure of oxygen and the total pressure constant and we only changed the partial pressure of carbon dioxide. Our results showed that white radish sprouts grow at the same rate as they do on Earth when the partial pressure of oxygen is half, the partial pressure of carbon dioxide is about 25 times higher, and the total pressure is about one-third lower, in comparison to Earth's atmosphere. We reached two conclusions. One of these is that it is not necessarily true that the higher the partial pressure of carbon dioxide is, the more the white radish sprouts will grow. The other is that a carbon dioxide partial pressure of about 1kPa is suitable to cultivate white radish sprouts on Mars.

## 発表5

### The Mystery of *Trapella sinensis* An Endangered Species in Tatsuno City たつの市の絶滅危惧種ヒシモドキの不思議

Hishimodoki is a plant that is an endangered species. It grows only in about 10 places throughout Japan, and inhabits only one place in Hyogo Prefecture. We wondered why it faces a threat of extinction, and that is why our research is about Hishimodoki.

We obtained three main results. ① Chasmogamous flowers bloomed only in a 90cm-deep pond. ② We found a few stomata on the back side of the land-type leaf. ③ The tendrils of the fruit which grew on land were shorter than those of the fruit which grew in water.

Therefore, Hishimodoki's original habitat must have been a floodplain and *Wanndo*. *Wanndo* is an inlet which is located near the lower stream and it is similar to a pond. In addition, the cause of Hishimodoki's extinction may be the disappearance of its original habitat caused by repair works on rivers, a lack of water, or a change in the depth of water due to repair work done on ponds, as well as its inability to transfer to other environments.

## 発表6

### Finding the Ideal Conditions to Make Yogurt ヨーグルトの条件による変化

When we made yogurt in our house, we wondered why the yogurt's taste changed every time. So we decided to research what conditions cause the changes in the yogurt's taste. This experiment's goal was to make yogurt that is easy for everyone to eat, is very sweet and is less sour without adding sugar and sweeteners. In addition, we aimed to make a yogurt which even a person who cares about their health could eat. We used a sugar content meter and pH meter in this research to measure the sugar content and pH because we were unable to eat the yogurts.

## 発表7

### Searching for Wind Power with the Right materials in the Right places ～Small-scale Wind Power Generation～ 適材適所な風力発電を求めて～小規模発電～

A general large windmill is powerful when powerful wind comes from a specific direction. In fact, these windmills are used the most in modern Japan. However, the climate of Japan has wind blowing in various ways, and there is not a large enough mass of land to set up a lot of windmills. So, we decided to make a small windmill that can deal with wind from multiple directions. After more and more discussions, we found the Savonius windmill was the best one for our purposes. However, Savonius windmills have a weak point. It is that the Savonius windmills can't produce a large amount of electricity. To solve this problem, we aimed to modify the Savonius windmill by combining it with the Gyromill windmill, which are easy to match due to using the same pivot type. Therefore, we made a Gyronius windmill. We are the first group to create this style of windmill.

## 発表8

### Study of Erosion Action by the Water Current 水流による侵食作用の研究

Have you experienced that it is hard to maintain a tennis court, or that when it rains, the tennis court gets rough? Our school tennis court is sloping in the north and south. Erosion occurs when it rains. In particular, erosion of the soil near the line tape is especially terrible. We made the model that reproduced the soil near the line tape, and we passed water through it, causing erosion. And we were able to obtain the result according to the hypothesis that as the line tape's surface coarseness became rougher and rougher, the degree of erosion action becomes smaller. Therefore, if you experienced this, or your tennis court gets rough and you would like to change the situation completely, you cannot help but try it. On hearing this lecture, you will definitely want to tell your tennis club members the truth right now. So, please listen to our lecture. And please tell your friends to deal with the erosion action on their tennis court.