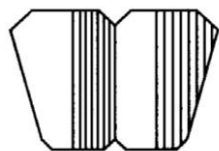


**THEMATIC RESEARCH II**  
**Annual Report on Research Activities**  
**Abstracts in English**



**2020**

**Kyoto Prefectural Rakuhoku High School**

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# The Observation of the Differences in the Way Soap Bubbles Burst Depending on the Component of the Soap Liquid

Yuko Tonami, Mina Ueno

## **Abstract**

We wondered what PVA's role was in keeping a soap bubble's shape. To figure this out, we focused on the appearance of the black spot. The black spot appears on the soap bubble when the soap membrane becomes very thin, so we thought that we can learn the change of the membrane's thickness by observing it. In the experiment, we gradually changed the proportion of the starch (its main component is PVA) in the soap liquid and made a hemisphere bubble. Our research showed that, when a small amount of starch is added, the time until the black spot appears and the bubble bursts both decreased as the amount of starch increased. However, when we increased the amount of starch to some extent, the soap bubble suddenly began to last for a long time. Also, when we increased the amount of PVA, the size of the black spot right before bubble bursting became bigger. In conclusion, we thought that starch (PVA) would be helpful for us in maintaining the soap membrane in a thin state and wide range, but it would quicken the time until the bubble breaks until we add a certain amount of it, maybe because it is easily affected by gravity.

**Keywords:** soap bubble, PVA, black spot

# Preventing Bacteria from Breeding Varied Substances

Akira Sawamoto, Manaho Ogiso

## **Abstract**

Due to the outbreak of the new coronavirus at the end of March 2020, rubbing alcohol was difficult to obtain. Alcohol is an industrial product used for various purposes, and it may become difficult to obtain again someday. In this research, we looked for something familiar and inexpensive that can prevent bacteria from breeding instead of rubbing alcohol. Then, we examined E.coli by counting colonies. First, we examined the antibacterial effect of foods that are known to have an antibacterial effect. We found that lemon and umeboshi have a great antibacterial effect, possibly because they contain citric acid, which has an antibacterial effect. Next we did an experiment with oranges and lemons, which contain citric acid, and 30 g/ml acid solution in order to examine citric acid's antibacterial effect. Then, we unified the amount of citric acid to 9mg contained in the sample. This research showed citric acid solution had the greatest antibacterial effect among what we examined. In addition, it was found that the citric acid solution had a greater antibacterial effect than the same amount of rubbing alcohol. Therefore, it seems that a 30g/ml citric acid solution can be expected as a substitute for rubbing alcohol.

**Keywords:** bacteria, rubbing alcohol, citric acid, antibacterial effect

# Keeping Your Hair Beautiful

Kanako Fujikawa, Fumika Sawasaka, Nanoha Yasuda

## **Abstract**

We checked on the relation between how long we add heat to the hair and what temperature the hair has, and tried to find out the resistance the hair has. Also, we examined the change in resistance of hair when we get a hair treatment or add a hair repairing material to the hair. We added heat to the hair with the hair iron, pulled it by the weight of water, and cut it. In another experiment, we got hair treatments before we added heat to the hair, and then we did the above-mentioned experiment. Our results showed that the higher temperature the hair has and the longer we add heat to the hair, the lighter the weight of water is. Also, when we got a hair treatment or a hair repairing material to the hair, the weight of water was heavy. We considered that when we use the hair iron in order to set our hair, we should use it for a short time and at low temperature as long as we can.

**Keywords:** resistance of hair, hair iron, heat

# Why does graphite migrate to paper?

## ~To protect handwritten drawings~

Kyoka Maeda, Syoko Mashimo, Rina Takashima

### **Abstract**

We sometimes have a problem when graphite migrates to paper. To prevent it we want to understand why it happens and find the way to avoid it. We made a hypothesis that it was easier for graphite to migrate when we write with dark pencils. We examined especially 2B, B, HB, F, H. We used black pencils made by Mitsubishi Uni, tracing paper, and black paper on which we wrote something such as straight lines or circles filled by graphite. Second, we piled them up, put them between boards, put an aquarium on them, and left them for one week. Finally, when one week passed, we observed how the graphite migrated to the paper through observing with a binocular microscope or checking the mass change of each piece of paper. We made the following. Although darker pencils are easier for graphite to migrate to paper, for 6B and 3B, it is easier for 3B to migrate. Regarding 2B~H, no clear change in mass was observed, so we couldn't find the darkness which is hardest for graphite to migrate.

**Keywords:** graphite, migration, darkness

# The Attempt to Make Adhesive by Using Polyvinyl Acetate

Shojiro Hori, Takuya Kira, Ryoichiro Oda

## **Abstract**

Adhesive generally contains water and polyvinyl acetate. We think changing the proportion of them affects the strength of glue. We constructed the hypothesis that the more polyvinyl acetate we use, the stronger we can make an adhesive. In order to make an adhesive, first, we made vinyl acetate into polyvinyl acetate by connecting it, and made polyvinyl acetate partly dissolve in water. However, we failed our experiments three times, so we could not make an adhesive. From these results, we found it difficult to make an adhesive by ourselves.

**Keywords:** adhesive, proportion, failure



# Do zebrafish have likes and dislikes?

Sogo Otsu, Ai Ozaki, Kaya Utsughi

## **Abstract**

We researched whether zebrafish have likes and dislikes by feeding them three types of food. Conditioning them to see colored papers corresponding to each food, we sought to confirm the question by their reaction to the paper. Moreover, by using colored papers instead of electric current, our experiment was more humane for the fish. Our results show that they have likes and dislikes. According to the experiment results, they liked Artemia the best, Tetra Min second and Red Worm third. We concluded that they obviously have likes and dislikes, but colored papers would not be an alternative method of electric current. We suspect that better-liked foods are connected to the amount of protein.

**Keywords** : zebrafish, colored papers, foods (Artemia, Tetra Min, Red Worm ), likes and dislikes

# The effect on the Learning Ability of Zebrafish Brought by Environmental Change

Tatsuki Hattori, Taiga Miyaoku, Shintaro Takegama, Hirai Yagi

## **Abstract**

We knew about research which shows the danger that fish may behave abnormally due to marine acidification. The reason why we guess they do is that they have to use more energy than necessary in order to avoid a harsh environment and we started a study to confirm our hypothesis by using zebrafish which live in fresh water. However, it is difficult to maintain acidity in the aquarium, so we chose a way to compare between normal keeping and 0.5% salinity keeping. Our study is a learning experiment where we compared the reaction between when we showed red on a screen, which meant we would give food, and when we showed blue, which meant we would give a shock: we did this twice a day. As a result, we could observe that the physiological cost made them difficult to study.

**Keywords:** zebrafish, marine acidification, physiology

# Breeding Fish and Ornamental Plants in a Balanced-Aquarium

Ayano Ogata, Yukiha Furuta

## Abstract

Preparing the environment of the aquarium needs a lot of electricity, and it has bad effects on earth such as global warming. Therefore, we examined the necessary condition of reducing those risks and breeding fish more easily. In our research, we prepared two types of PET bottles of different sizes for the tank, and put one fish, one ornamental plant into such of them. By using this equipment, we experimented which size of PET bottles can make more numbers of fish survive than another. The pH and DOD figures were checked with exclusive equipment, and we checked visually on the water quality. At that experiment, fishes were not fed for three weeks out of four weeks. As a result, all fishes in 500mL PET bottles died, and 3 out of 4 fishes in 1500 PET bottles survived. There was no variation of pH and DOD figures, but water quality of 500mL PET bottles got much worse than 1500mL PET bottles in appearance. From these results, we considered that the size of bottle does not affect the volume of respiration, therefore pH and DOD figures did not vary, but that closely related to water quality. We estimated that because of deterioration of water quality, fishes in 500mL PET bottles died. Based on these considerations, we concluded that 500mL PET bottles are not fit to breed fish.

**Keyword: pH, DOD**

# The Capability of Concept Cognition of Zebrafish

## ~Experiment on Shape Cognition~

Seiichi Honma, Masaki Sohno, Yuto Tanaka

### **Abstract**

We humans grasp things we see by connecting them with the information of other similar facts we have learned in the past. This is concept cognition, and it is said that only humans have this ability. However, we thought fish also has this ability because they can tell their companion from their natural enemy immediately. In our research, we made zebrafish memorize two different shapes by feeding them or giving electric shock when showing a particular shape, and observed how they moved when randomly shown either of the shapes. Our results showed they didn't show specific reaction in any case. From the results, we concluded they couldn't identify the shapes we used in the first place, and we couldn't get any valuable information about their ability of concept cognition.

**Keywords:** concept, cognition, shapes

# Memory Experiment Using Planarians

Mizuki Fukui, Satomi Ikari, Saki Naganishi, Moe Yoshida

## **Abstract**

Planarians are a kind of leech. They avoid light, and can remember. We researched whether they would approach food when they were hungry, and if they knew their food was in the lighted place, whether they would move toward the place. In our research, we divided them into two groups, one is full, and the other is hungry. Then, we compared the speed of them going to the light. Our results showed that the hungry group moved toward the light faster than the other group. However, in both groups about half of them didn't move, or moved opposite to the light. These results indicate two possibilities. One is that the frequency of feeding is too high, so some of them didn't move. The other is that they dislike light so much that even if they could get some food, they will not move.

***Keywords;* planarians, lighted place, speed**

# The Succulent Plants' Callus Culture and Redifferentiation

Tomoha Kojima, Fumika Ogawa, Megumi Tanaka

## **Abstract**

Callus is a plant cell mass that is amorphous and can differentiate into various tissues. When the leaves of succulent plants, whose leaves and stems contain a lot of water fall, callus is formed on their cut ends. We thought that the speed of the formation of callus and the look of the redifferentiation differed depending on the quantity of nutrients and hormones contained in the leaves. We used four succulent plants of two kinds and cut the apical buds from two plants, and recorded how long it would take until the callus redifferentiation. We also cultured part of the leaves in culture mediums and tried to make callus. Our result showed that the speed of the callus redifferentiation differed from variety to variety but was not affected by the position and weight of leaves and whether the plant had had the apical bud or not. The culture ended in failure and we could not make callus in culture mediums. From these results, we conclude that we have to change the concentration of the hormones and circumstances widely and accurately to affect the callus formation and redifferentiation.

**Keywords:** callus, redifferentiation, hormone, succulent plant

# Can fish distinguish human faces?

Risa Kinoshita, Noe Kimura, Aoi Sakurai, Tomoe Takabayashi

## **Abstract**

Some mammals, birds, and even insects can distinguish human faces. We learned that archerfish, which prey on insects by shooting water from their mouth, can distinguish human faces, so we conducted experiments to find out whether zebrafish can also do this. In our research, we trained zebrafish to recognize two faces by using feed as a reward and an electric current as a penalty. Then we tested whether they could distinguish those faces. Our result showed they gathered more at the face that we showed to them while applying an electric current, or they gathered at neither of the faces. From these results, we concluded that zebrafish cannot distinguish human faces. We assume that this is because zebrafish don't need to prey on insects, so they don't have the ability to watch things carefully, unlike archerfish.

**Keywords:** zebrafish, distinguish, recognize, human faces

# The Effect of the Mask in Communication

Tensho Funakoshi, Tomaya Kimura, Yuma Kurashima, Takuto Oshima

## **Abstract**

We must wear a mask because of the pandemic, so we tried to find a better communication method from mask's comments. In our research, we prepared a listening test in order to research the effect of masks on voices and communication. Next, we prepared a questionnaire about the impression of clear masks. As a result, there was no significant difference in dB, Hz. Also, it is more important to move the mouth than the area around the eyes. It also revealed that students want to wear normal masks and want our teachers to wear clear ones, from our questionnaire.

**Keywords:** mask, effect, communication



# How to Use Your Own Voice by Questionnaire and Frequency Analysis

Shiori Nishimoto, Kanako Zushi

## **Abstract**

We want you to know the advantage of your own voice and to communicate smoothly, so we started to examine what kind of voice people like depending on each situation or gender. We sent two questionnaires to 228 students, and the participants listened to the voices we prepared. We analyzed them into frequencies. Our results from the questionnaires showed that the voices people like are different from situation to situation or gender. We also found what those voices have in common, such things as pitch, speed, clarity, and age. From these results, we conclude that the likable voices vary from situation to situation or gender, so we can safely say that each person has the chance that they can use their own voice efficiently.

**Keywords:** voice, pitch, speed, clarity, age

# **Influence of Picture Books on Children Showed from Rakuhoku High School Students**

Takahashi Nahoka, Mitsushima Mei

## **Abstract**

We carried out our research to find the effect of picture books on children and to see if they have some effect even on high school students. In our research, we sent a survey on what Rakuhoku students learned from picture books, when they read them, how much they were affected by them, and how they got the books. In addition to this survey, we sent another survey on Instagram to find how much picture books affected older people when they were high school students. Our results showed few links among the categories we searched. From these results, we conclude that high school students are significantly affected by picture books, but that they will be affected by many other things through their growth, so we could not find a clear connection.

**Keywords:** picture books, high school students

# Plastic = evil?

Erika Kubo, Manami Tsukada

## **Abstract**

These days the issue of plastic waste is being talked about. However, due to the influence of COVID-19, many shops and restaurants have started takeout. We thought this would cause more plastic waste. In our research, we interviewed two companies, MARUGAMEUDON and McDonald's, about the materials they use for the containers, their opinions on the environment and the problems they face when they enforce environmental protection. Both of them work on environmental protection. Second, we asked Kameoka city. They are trying different initiatives such as a coupon campaign and the introduction of paper containers. Therefore, it is thought that the most important thing for us is to be interested in environmental issues and to act in cooperation with companies and local governments. We want to think about how to utilize it in the future.

**Keywords:** plastic, environment

# What makes agar hard?

Chiori Nakajima, Nodoka Shimo, Ryoko Matsumoto

## **Abstract**

We studied what makes agar hard, particularly  $Mg^{2+}$  and  $Ca^{2+}$ . From a study last year, it was considered that high hardness water makes agar hard. However, all the results were surveyed by questionnaire. We tried to prove what makes agar hard, focusing on  $Mg^{2+}$  and  $Ca^{2+}$ , because water hardness is measured by the level of salt, such as  $Mg^{2+}$  and  $Ca^{2+}$ , in water. We made 10 agar gels with 5 types of water in 10 test tubes and measured their melting points. In our research, agar which has a high melting point is considered hard. Our results showed that agar with distilled water always melted first. Thus, we can conclude that the more impurities water contains, the harder agar becomes. Therefore, we can say that the consideration of the study last year was true.

**Keywords:** agar, hardness,  $Mg^{2+}$ ,  $Ca^{2+}$ , melting point

# Economical Structure of Building

Shiryu Seki, Rintaro Takahata, Haruki Maru, Ryohei Yamasaki

## **Abstract**

These days, the international pandemic of Corona virus occurs all over the world. Therefore, people pay attention to ventilation, which is regarded as a precaution to protect people from spreading the infection. We suspected that changing the shape of a room leads to effective ventilation and we did an experiment based on the idea.

In our research, we prepared four differently shaped solid models, made out of plastic. We produced smoke by using a smoke machine and blew air towards the models. Our result showed that air in the regular icosahedron was circulating most efficiently of the four shapes. For this reason, we expected that the closer to a sphere shape the model was, the more efficiently the air in the solid model circulated. For further research, we have to examine what types of shapes are most useful for our lives.

**Keywords:** corona virus ,circulation, solids

# **What Hobby Makes You Happy?**

## **~The Relationship Between Hobbies and Subjective Happiness, and the Change in Hobbies by COVID-19 Pandemic~**

Azusa Nakamura, Rena Hojo

### **Abstract**

The purposes of this study are to clarify the relationship between hobbies and subjective happiness, and to propose a new lifestyle which people can keep themselves happy even when they cannot live as they want because of COVID-19 pandemic. We conducted a questionnaire survey on Rakuoku High School and Junior High School students and analyzed the data. As a result, we found that hobbies were deeply related to subjective happiness and could guess they maintained their happiness by increasing the time to enjoy their hobbies during the self-restraint period.

***Keywords:* hobby, subjective happiness, COVID-19, self-restraint period**

# The Relationship Between Colors and Appetite

Yuki Hasegawa, Shiori Nishimoto

## **Abstract**

Generally speaking, it is said that warm colors promote appetite, and that cool ones reduce appetite. We researched whether it is true, and would like to suggest how to take pictures in order to promote more appetite. We investigated through a questionnaire survey in what cases appetite would increase. As a result, when the color of each dish was processed, many people felt that green and yellow looked delicious. Therefore, it is concluded that people can be motivated by changing the background colors of advertisements made for the general public to so-called “natural colors”.

**Keywords:** appetite, warm colors, cold colors

# Do you know about agricultural technology?

Shimada Hazuki, Nishiyama Kaho, Hamao Tomoha

## **Abstract**

Farming in Japan has the serious problem of an aging population. We found that agricultural technology is a solution to the problem, but it has not spread yet in Japan. Thus, we want to find out why it has not become common and have started this research. We expected that the main obstacles would be the cost of its introduction and the difficulty in using it. Furthermore, to make it widespread in Japan, farmers would need financial support. From these results, we conclude that the reason why agricultural technology is not widely used is that Japanese farmers have financial constraints. Therefore, we think what farmers want is smaller and cheaper machinery. Our results showed 64% of farmers expected to adopt agricultural technology. Staffs of agricultural technology companies were sure that farmers would make a profit.

**Keywords:** agricultural technology, farmers, financial support



# The Effect of Spill Holes and Their Layouts on the Way a Parachute Falls

Nami Adachi, Kenta Iida, Chinatsu Natori

## **Abstract**

We learned that some parachutes have holes on their canopy. They are called “spill holes” and they help parachutes fall more stably. We decided to research the effect that the number and layout of holes have on a parachute’s fall. We constructed the hypothesis that the more holes a parachute has, the more stably it will fall. In our research, we made 6 models of parachutes using polyethylene plastic bags, each with a different number of holes. We dropped these models and observed and compared each model’s trajectory and speed. Our results showed that the parachute with 4 holes swung the least, and that the speed of parachutes was relatively consistent regardless of the number of holes. From these results, we conclude that parachute trajectories change depending on the number of holes, but that when the size per hole becomes bigger than is appropriate, there seems to be no difference in their trajectories.

**Keywords:** parachute, spill holes, trajectory

# The Strength of “Tsugite”

## ~ The ancient building techniques of Japan ~

Ruka Nishida, Takumi Sumiya, Konatsu Teraoka, Shohei Yukawa

### **Abstract**

“*Tsugite*” has been used to connect wood for a long time in Japan. We focused on it and conducted an experiment to find what effects *Tsugite* structures have. In this experiment, we prepared wood connected by *Tsugite*, and defined the “strength” of *Tsugite* as the weight it could endure when pressure was pressed on joints. We used four types of “*Kanawatsugi*” in the experiment. We expected that the larger the cross-sectional area was, the bigger the frictional force would be, and therefore the greater the “strength” would be. However, from the results of the experiment, we found that there was no relationship between the cross-sectional area and the “strength” of *Tsugite*. On the other hand, if the structure was changed, the "strength" was also changed, even using the same type of *Tsugite*.

**Keywords** : *Tsugite*, *Tsugite* structures, four types of “*Kanawatsugi*”, the “strength”

# Water-Cooling Device Applied to the Hot Side of a Thermoelectric Cooler

Nene Akahori, Fuga Itagaki, Arata Fujimoto, Madoka Yamazaki

## **Abstract**

Technologies have developed recently, and modern devices do much more processing, and easily get hotter than before. In order to prevent them from overheating, a more efficient cooling system is needed. We investigated a way to use water as a means of cooling them. In our research, we put Peltier devices, which are one type of the thermoelectric devices in PCs, on a metal plate, and heated the metal in various situations. After heating, we recorded the temperature of the plate. Our results showed that, by dripping water, we can cool the metal faster. Especially, when the temperature of the metal plate was above 100 degrees Celsius, the metal was cooled in a much shorter time. From these results, we conclude that using water's vaporization enables us to absorb the heat efficiently. Water cooling is useful when the temperature is high enough to evaporate water.

**Keywords:** water cooling, Peltier device, water vaporization

# How to Measure the Distance Between Two Points on the Earth

Tomoya Otake

## **Abstract**

As we become more internationalized, we are expected to measure long distances accurately and easily. I studied the accuracy of existing equations for finding the distance between two points (Spherical trigonometry, Huveni's equation) with the aim of creating my own equation for finding distances. I compared the calculation results of these formulas with the true values, and examined why such errors occur. As a result, I was not able to create my own equations, which was my first goal, but I learned the following. The method using Spherical trigonometry is more complicated to calculate, but it is less prone to make errors even over long distances. The method using Huveni's equation is easy to calculate, but the error becomes extremely large when the range exceeds 1200 km from north to south and 3000 km from east to west. From the above, I was able to find some points for improvement, which I would like to examine in the future.

**Keywords:** Spherical trigonometry, Huveni's equation, measuring long distances

# The Power Law of Fall Impact with Jelly

Kento Igarashi

## **Abstract**

There are many natural phenomena which act based on the power law. This law is expressed in the formula, “ $y=bx^a$ ”. When you take the common logarithm of both sides, it changes to the straight line of slope  $a$ , intercept  $b$ . I thought that the distance of each range regularly from the fall point and the total mass of the broken piece scattered on each range might follow this law. In my research, I made agar jelly and dropped it from the second floor of my school. After each drop, I caught a piece of jelly with a spoon and measure its mass. My research showed that the value of the range away from the fall point approximated to the straight line, but that the closer to the fall point broken pieces landed, the larger the gaps became. Also, the spread of the data of the same range was as big as I expected. From these results, I conclude that it is easy for big pieces of broken jelly to stay less than 25cm from the fall point, while small pieces are likely to scatter, following the power law.

**Keywords:** power law, common logarithm, agar jelly

# Setting Difficulties of Sudoku Problems by Using T-Algorithm

Hinata Tokuda, Hikaru Kojima

## **Abstract**

These days, “Sudoku” or “Number place” is very popular all over the world. However, there was no sufficient measure to evaluate Sudoku’s difficulties. Therefore, we defined the new one named “P-score”, which is calculated by using an algorithm to count up all the solutions of a given Sudoku grid. We made such an algorithm and calculated the P-score of around 700 problems, and checked how accurate it is. Our results showed that there was a certain relation between P-score and Sudoku-entropy, another indicator of Sudoku’s difficulty proposed by Zhe Chen. The correlation coefficient was 0.826. We also found a relation between P-score and the claimed difficulty of DAISO Sudoku. On the other hand, there was no relation between P-score and the claimed difficulty of Byakuya-shobo’s Sudoku. We suspected that this was the result of the tendency for P-score to be widely affected by the number of empty cells. We conclude that P-score’s accuracy is not high because it does not reflect how a person solve the problem. Still, since no effective way to evaluate the difficulties of Sudoku problems is found yet, we believe that P-score is a useful method to set a difficulty.

**Keywords:** Sudoku, number place, difficulty, algorithm