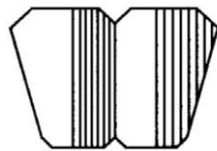


THEMATIC RESEARCH II
Annual Report on Research Activities
Abstracts in English



2019

Kyoto Prefectural Rakuhoku High School

Contents

Chemistry

Chemiluminescence by Using Luminol Reaction	1
Juri Kitagawa, Misa Nakagawa, Minami Nakashima, Sawa Yamazaki	
Herb's or Tea Leaves' Antibacterial Properties	2
Wakana Hashiba, Akane Tsujikawa, Elena Wada	
Changing Inorganic Pigment Colors Using Redox Reaction:	3
Nanaho Kanda, Rin Masuda	
The Function of Water Quality Purification by Using Activated Carbon Made by Food Waste	4
Aiko Azuma, Ai Konishi, Aoi Yamada	
The Relation Between Water and Roughness of Paper from Drying Rate	5
Rin Imbe, Mio Kawabe, Himari Takemura	
Determination of Saponin Extracted from Vegetables	6
Mayuka Egawa, Ayane Ishimoto, Kinako Mizutani, Ai Ushiro	

Biology

Do Arthropods Avoid Dangerous Smells ?	7
Takuma Goto, Tomoki Ishii, Kengo Shiojima	
Let's Collect Garbage in the Water with Natto	8
Miyu Imanishi, Nanako Koyama, Aoi Kurita, Kaho Yamamoto	
Zebrafish seeing a fellow's fear behavior was frightened and submerged, too.	9
Shunsuke Kuroda, Kosei Kurosawa, Itsuki Murakami	
Examining the Distribution of Bluegill (Lepomis Macrochirus) in Lake Biwa Canal by Using eDNA	10
Seita Kawamoto, Hisashi Shimamura, Akito Tanoiri	
Characteristics of Caddisfly-silk	11
Shuto Kojima, Jun Nomura, Yuri Siotani, Eitaro Yasui	
Lowering the Aggressiveness of Leucauge Blanda Induced by Cold Medicine	12
Sota Kayano, Kazushi Matsubara, Seiya Umehara	

Environment

Examining of Syui-syu by Literary and Linguistic Analysis	13
Midori Asukai, Yuka Hanaoka	

Pleasure by Using and Getting Approval on SNS in Present Society	14
	Shogo Kubo, Sora Tomita
The Roles and Revitalization of FM Radio	15
	Miyu Ogawa, Yui Nakajima
Change the Environment with Billing!	16
	Kotone Horikawa, Suzuyo Murakami
Popularization of <i>Igo</i> Among Young People	17
	Haruka Hikawa, Ken Morita, Kengo Taketani, Akise Taniguchi
Development of a Board Game for Natural Disasters	18
	Kohei Higashitani, Kai Miura, Tamaki Yaga
Is Vegetarianism Really on Friendly Terms with the Environment?	19
	Satoko Fukushima, Mayu Tomomitsu
Relationship Between Groundwater and Wagashi	20
	Hana Ishida, Mayuko Maekawa, Mao Nagata

Physics & Geology

Dilatancy	21
	Yuka Matsumura, Mioko Murashima, Mako Shirai, Sota Takemori, Yugo Yamazaki
The Energy Storage System Using Small Rotating Bodies	22
	Ryota Kamewaka, Kodai Mino, Shun Naito, Tomohiro Takamido
Creating a Spatial Projection System Using Retroreflection	23
	Eiji Horimoto, Mina Nishioka, Rona Brown, Yojiro Zushi

Mathematics

Arrangement of Two Points which Minimize the Maximum Distance Between Given Points in a Domain and Points P and Q	24
	Shota Imai
The Conditions of a Unique Formation of Pieces in Ubongo	25
	Ato Matsuda
Relation Between Joker's Initial Position and the Odds in Old Maid	26
	Taiyo Kitayama
The Locus of the Triangle Center When Moving One Vertex of a Triangle	27
	Yuto Yagi

Chemiluminescence by Using Luminol Reaction ~ Give Off Light in Darkness! Be a Hero in Disasters! ~

Juri Kitagawa, Misa Nakagawa, Minami Nakashima, Sawa Yamazaki

Abstract

In Japan, there are a lot of disasters, and blackouts often happen, so we want to create light which can last longer and be brighter. To create light we use chemical reaction called Luminol reaction. By changing the amount of a catalyst, the concentration of Dimethyl Sulfoxide and the figure of pH, we tried to cause a Luminol reaction and create chemical light which can last longer and be brighter when a disaster happens. When the level of pH is pH13.1, pH13.3 and pH13.4, solutions gave off light strongly but briefly. The solution of pH11.1 gave off more stable light than pH10, pH12.1 and pH12.8. When looking at only brightness for 1 minute, the solutions containing 0.15g and 0.20g of catalysts were brighter than 0.05g and 0.10g of catalysts. After 1 minute, the solutions containing smaller amounts of catalysts were brighter than the ones containing larger amounts. These results indicate that the optimum level of pH is around 11. For light to last longer, the optimum amount of the catalyst is around 0.10g.

Keywords: light, chemiluminescence, luminol, $K_3[F_3(CN)_6]$, the level of pH

Herb's or Tea Leaves' Antibacterial Properties ~To Produce a Natural Antibacterial Spray~

Wakana Hashiba, Akane Tsujikawa, Elena Wada

Abstract

Some plants have antibacterial properties or disinfection. Based on the fact, we thought that by examining herbs' or tea leaves' antibacterial properties for colon bacilli, we can make use of the effect to minimize food poisoning. We thought producing natural substitutes will lead to an eco-friendly and healthy life because antibacterial sheets, which are used in lunch boxes, end up as trash. We chose 9 kinds of familiar herbs and tea leaves, and focused on concentration, hydrophilic components, and oleophilic components to verify their antibacterial properties against colon bacilli. We examined the increase of colon bacilli by measuring turbid difference with a spectrophotometer. Our results showed that matcha (powdered green tea) has the greatest effect from both hydrophilic and oleophilic components, and that as for hydrophilic components, the turbid difference was +0.718 (distilled water was +1.500) and as for oleophilic components, -0.336 (distilled water was +0.870). All plant substances showed greater effects with oleophilic components, so we have to consider about how to make use of them in a practical spray for consumers.

Keywords: antibacterial properties, colon bacilli, herbs, tea leaves, food poisoning

Changing Inorganic Pigment Colors Using Redox Reaction: Changing Prussian Blue into Berlin Green

Nanaho Kanda, Rin Masuda

Abstract

We were interested in faded color of pigment, seen in paintings in art, and want to find out the way to return the faded color to its original color. We found out that color is faded partly because of redox reaction. In our research we tried to change a pigment's color by redox reaction, thinking we might apply this research finding to returning faded pigments' colors. We found out in a previous study that by oxidizing Prussian blue, the blue color changes into Berlin green, very chemically unstable color, and finally changes into Prussian yellow. Considering this, we hypothesized that we can keep the green color by stopping that reaction mid-way and we can find the reagents suitable to keep the green. We put the blue into oxidants to oxidize the pigment and make Prussian green, and by the time the blue changed through green into yellow, added reducing agents to it to stop the redox reaction. We conducted these experiments using many combinations of oxidants and reducing agents, for example calcium hypochlorite aq and sodium thiosulfate aq. As a result, we were able to make the blue green when using a combination of the reagents, but in the other experiments we could not. We thought that the reason for these failures was that the power of the oxidants does not match with that of the reducing agents, and we also found that we had no accurate method to identify the green generated through the experiments as Berlin green.

Keywords: redox reaction, Prussian blue, Berlin green, oxidants, reducing agents

The Function of Water Quality Purification by Using Activated Carbon Made by Food Waste

Aiko Azuma, Ai Konishi, Aoi Yamada

Abstract

A good deal of food waste is a social problem in Japan. We learned a way to make activated carbon by using the core of corn. Therefore, we thought that we could suggest an effective way to make and use activated carbon depending on its conditions and function. In our research, we made activated carbon from food waste and examined whether it is as effective as commercially available activated carbon. Our result showed, even though the activated carbon that we made was inferior to the commercially available activated carbon, we were able to make activated carbon that has the function of water purification. However, the success depended on the amounts of certain ingredients or activators. Moreover, an action that we did not intend appeared or an obstacle occurred when we preserved the activated carbon. Thus, it seems to be difficult to make the same quality of activated carbon consistently and to decide the best numerical value of the activators or the best conditions to make it.

***Keywords:* activated carbon, food waste, water quality purification**

The Relation Between Water and Roughness of Paper from Drying Rate

Rin Imbe, Mio Kawabe, Himari Takemura

Abstract

We want to figure out how to get rid of wrinkles from wet paper. According to a preliminary experiment, when a heavy weight is applied to wet paper, the drying rate is high but the paper had a lot of wrinkles. When the weight is light, the drying rate is low but the paper had fewer wrinkles. Therefore, we constructed a hypothesis that there is a proper weight that enables us to write normally on the paper but does not create many wrinkles on it. We prepare 6 sets of 30 pieces of paper cut 5 square centimeters, 12 acrylic panels, a micrometer and weights of 20g, 50g, 100g. First, soak thirty pieces of paper in water for 3 minutes and put them in between two acrylic panels. Second, put them in a shelf and measure the weight and thickness six times during eight days. We also calculated the drying rate. The results indicate that the drying rate doesn't change even when we change the weight. However when we used a 70g weight on the pieces of paper, they had the fewest wrinkles and we were able to write normally on them. The reason why the thickness of the paper increased after two or three days passed is that the surface tension of the water in the wet paper which we couldn't shake off enough was great until the pieces of paper started to dry. After that, the thickness decreased because the water evaporated and the amount of water in the pieces of paper decreased. We can't find the relation between the thickness of the paper, the drying rate, and the heaviness of the weights because the weights we used on the pieces of paper were too light.

Keywords: paper, wrinkles, drying wet paper, surface tension

Determination of Saponin Extracted from Vegetables

Mayuka Egawa, Ayane Ishimoto, Kinako Mizutani, Ai Ushiro

Abstract

Saponin is a substance which has hydrophilic and lipophilic parts, and dissolves when it is mixed with water. When you shake it, it makes a lot of bubbles like soap. The purpose was to determine the amount of plant-derived saponin by comparing the results of saponin reagent with those of plant-derived saponin. We expected that it is possible to quantify by using that method, that more saponin is provided when we use more vegetables, and that therefore surfactant action becomes strong, too. We used carrots, soybeans, and saponin reagent in this experiment. We extracted saponin by putting carrots and soybeans in ethanol and evaporating the ethanol in hot water. We added oil and water to the extract and separated into two layers. Then we took the oil and water and compared the results. It can be seen that there is a large mass of saponin contained in the order of carrot 50g + soybean 50g < carrot 100g + soybean 100g < saponin reagent. However, accurate measurement of saponin could not be made. We consider it difficult to quantify the mass of saponin in our method.

Keywords: saponin, hydrophilic, lipophilic, surfactant action

Do Arthropods Avoid Dangerous Smells ?

Takuma Goto, Tomoki Ishii, Kengo Shiojima

Abstract

It is said that many arthropods avoid smells given off by carcasses of others probably because they are afraid of epidemic or something else lethal. We conducted experiments using them aiming at producing insect repellents or agricultural chemicals. We observed how pill bugs reacted to the smells of carcasses, tomatoes, rosemaries or dried squids under different conditions. We used a T-intersection made by paper and plastic to clarify their reaction. Also, in some experiments, we made pill bugs hungry to find out what made them react as we observed. Each pill bug responded quite differently. Some did not react at all, while there was even one which started climbing carcasses. However, we got results implying that pill bugs had certain concerns for the carcasses; pill bugs showed no reaction toward tomatoes or rosemaries, whereas they showed at least some reaction toward carcasses.

Keywords: arthropods, carcasses, insect repellents, agricultural chemicals, pill bugs

Let's Collect Garbage in the Water with Natto.

Miyu Imanishi, Nanako Koyama, Aoi Kurita, Kaho Yamamoto

Abstract

Our group researched the water purification effect of Natto. We want to collect garbage thrown away into rivers. We want to find a method that does less harm to the environment. We learned from preceding studies that Natto has the effect of cohesion. We thought garbage would easily stick to PGA (polyglutamic acid), which is a sticky substance of Natto, because we could increase its viscosity by grinding it. In addition, we assumed that biological waste such as algae could be collected with Natto, but PET bottles couldn't be collected, while papers could be collected. For the first experiment, we extracted PGA from Natto. Second, we identified PGA that suits water purification. Finally, we observed conditions by using various types of garbage. From the results of experiment 1 & 2, we found PGA that is stirred many times is the most effective for cohesion. We did experiments with plastic bottles, paper, soil, and compost. PGA cohered to garbage, such as paper, soil and compost, but PGA didn't cohere to plastic bottles. These results indicate that PGA coheres to some things but does not cohere to others which are not in the variety of garbage, for example, oil and chemicals. We thought that we couldn't see any particular water purification effect with PET because PET is smooth. We will continue to examine PGA to find out which type of garbage reacts to it and how it reacts.

Keywords: PGA, the effect of cohesion

Zebrafish seeing a fellow's fear behavior was frightened and submerged, too.

Shunsuke Kuroda, Kosei Kurosawa, Itsuki Murakami

Abstract

Zebrafish (*Danio rerio*) have an alarm substance. It is in their epidermal and releases when they are attacked by predators. Those which have received it submerge or freeze. These reactions are called fear behavior. We conducted experiments to figure out whether or not zebrafish communicate fear by sight. We prepared a tank with zebrafish in it. We observed them seeing a movie of normal zebrafish or scared zebrafish. As a result, the dive time decreased when they were viewing the zebrafish image in the former condition, and they were found to be reassured when they saw their fellow zebrafish. In addition, it was confirmed that the submerging time increased when the latter was shown, and we found that they convey their fear to others by submerging.

Keywords: zebrafish, alarm substance, fear behavior, submerging, sight

Examining the Distribution of Bluegill (*Lepomis Macrochirus*) in Lake Biwa Canal by Using eDNA

Seita Kawamoto, Hisashi Shimamura, Akito Tanoiri

Abstract

Native ecosystems in Japan have been destroyed by bluegills, invasive fish. However, examining the distribution of bluegills by capturing method costs a lot of time and money. On the other hand, by examining water in rivers, a researcher can easily figure out whether or not a target species lives there because the water contains DNA (called eDNA) released by organisms. Therefore, we aimed to clarify the distribution of bluegills in Lake Biwa Canal by examining eDNA. Clarification of the distribution will help the extermination of them. We got sample water from 20points, extracted eDNA from these samples, and examined whether or not bluegills' DNA was contained in them by multiplying the DNA in PCR experiment. We got a result showing that all points were negative, even though several points must be positive because we saw some bluegills there. Hence, we doubted the result, and looked into the process of our experiment. We now suspect that something is wrong with our extracting process.

Keywords: eDNA, Lake Biwa Canal, bluegill, PCR experiment, water

Characteristics of Caddisfly-silk

Shuto Kojima, Jun Nomura, Yuri Siotani, Eitaro Yasui

The Caddisfly can attach threads made of protein to stones under water, so we supposed that caddisfly silk could be used as under water adhesive. Then, we investigated its adhesion to artifacts and conducted an elemental analysis of caddisfly silk. We investigated the adhesion to rubbery tubes, clear files, slide glasses, wraps, and other artificial objects with smooth surfaces and observed the bundle part of the fiber of Caddisfly-silk and the adhesive part to the stone.

We examined the types of elements in the Caddisfly-silk samples collected in the river and the silk artificially produced in tap water. Our results showed they didn't attach threads to all the artifacts and caddisfly silk is made up of about five fibers. In addition, caddisfly silk has oxygen, carbon and nitrogen. From these results, it is considered that Caddisfly-silk cannot be bonded to soft materials. It seemed that from two to five fibers are bundled together to form one fiber, and that therefore the fiber is stronger, as for the adhesion to stone. The force applied per area by increasing the adhesion surface may have helped to bond more strongly than by reducing it. Although it is unknown about the reaction of calcium, nitrogen, and chlorine, it is possible that inorganic substances play an important role in the protein; only silicon collected from the river had a reaction. Organisms containing silicon dioxide are flowing and entangled, and it is highly probable that Caddisflies feed on them.

Keywords: Caddisfly, silk, fiber, silicon

Lowering the Aggressiveness of *Leucauge Blanda* Induced by Cold Medicine

Sota Kayano, Kazushi Matsubara, Seiya Umehara

Abstract

Spider silk attracts attention in industrial fields because it has both strength and lightness. However, spiders have high aggressiveness, and a large quantity of spider silk is expensive because they often feed on one another when we breed them in a narrow cage. If we can reduce the aggressiveness of spiders by medication, we will be able to produce large amounts of spider silk at lower cost. We focused on caffeine as medicine. We administered cold medicine, which includes caffeine, to 10 spiders with spray, changing concentrations of the medicine, and we observed them. In the end, 3 in 10 spiders died, and 2 spiders had eggs. Thus, we could not judge whether cold medicine has an effect of lowering the aggressiveness of spiders.

Keywords: spider silk, cold medicine, aggressiveness, cannibalism, medication

Examining of Syui-syu by Literary and Linguistic Analysis

Midori Asukai, Yuka Hanaoka

Abstract

Syui-syu is a Japanese poems anthology, which was compiled in the Heian period. It is an official anthology. However, there has been no way to identify who made it. Therefore, the purpose of this study is to reveal who is the selector of it. In our hypothesis, it seems that Kazan-in or Dainagon-Kinto or Fujiwara-Nagato compiled it. We used five collections of Japanese poems: Syui-syu (poems about love or seasons), Syui-syo (poems about love or seasons), poems of Kazan-in, Dainagon-Kinto-syu and Nagato-syu. We counted the number of Makurakotoba, Jokotoba, Kakekotoba, Engo, and Taigendome in these five collections. We are to show the data which we examined in each collection of Japanese poems in order of Makurakotoba, Jokotoba, Kakekotoba, Engo, and Honkadori. The data of “Syui-syo” were 0.075, 0.043, 0.180, 0.084, 0.050, those of “Dainagon-Kinto-syu” were 0.012, 0.004, 0.239, 0.074, 0.032, those of “Syuiwaka-syu” were 0.132, 0.160, 0.248, 0.119, 0.038, those of poems of Kazan-in were 0.053, 0.018, 0.132, 0.053, 0.044, and those of “Nagato-syu” were 0.061, 0.014, 0.102, 0.027, 0.102. The results of “Syui-syo” and “Dainagon-Kinto-syu” indicate that there is a certain relationship between the poems written by a person and those selected by the person. Those of “Syuiwaka-syu”, poems of Kazan-in, and “Nagato-syu” indicate that Fujiwara-Nagato did not elect “Syuiwaka-syu”, but we did not make out whether Kazan-in or Fujiwara-Kinto selected it.

Keywords: Syuiwaka-syu, rhetoric, Japanese poems, Kazan-in, Fujiwara-Kinto

Pleasure by Using and Getting Approval on SNS in Present Society

Shogo Kubo, Sora Tomita

Abstract

We noted the need for approval on SNS (social networking services or social media, which are often used by young people today). In this research, a question was asked, “Why do you bother posting your personal information on the Internet, which can be viewed by an unspecified number of people?” In addition, we hypothesized that the main reason for posting private information on SNS is the need for approval. We conducted a questionnaire survey of 68 second-grade students at Kyoto Prefectural Rakuhoku High School to verify this hypothesis. According to the survey results, unlike the hypothesis we initially set, the target students posted photos and descriptions of what had happened in their daily lives and used them as “memorandums” that could be recorded semi-permanently in digital format. Many people simply posted what they thought or felt as “one person”, and few people used SNS to fulfill their needs.

Keywords: need for approval, SNS, young people, Internet, memorandums

The Roles and Revitalization of FM Radio

Miyu Ogawa, Yui Nakajima

Abstract

About 35 years after radio broadcasting started in Japan, radio was closely linked to Japanese people's lives. However, information collection methods have been diversified due to the spread and development of social media, and radio has gradually moved away from their lives in recent years. In particular, the radio audience rating of young people has been decreasing year by year. Therefore, we aimed to improve the rate of young people listening to FM radio, which is more familiar to them than AM radio, and to investigate the roles of radio at the present time. Also, we studied the ways of revitalizing the radio. Our surveys by questionnaire showed that what the audiences thought of as the greatest charm of radio was that people can listen to the radio while doing different things. The reasons why people do not listen to the radio were that they have no interest in the radio and that they think the Internet is better. What the audiences viewed as the roles of radio were reporting disasters and broadcasting music, and they also used television and social media and regarded their quickness of reporting as an important characteristic. Besides, our surveys by interview showed that what the radio stations thought of as the charm of radio were that radio programs are broadcasted by using voice, only humans can transmit radio signals, people can get a sense of security by listening to the radio, and that when people suffer from a disaster, they can cooperate with outside institutions and send correct information to their audiences. From these results, we conclude that the roles of radio are sending correct information during disasters, snuggling to the audience and serving as entertainment, and that in order to increase its listenership, it is necessary to let many people know the characteristics and convenience of radio during disasters.

Keywords: FM radio, audience rating, role of radio, revitalization of radio

Change the Environment with Billing!

~About SDGs ~

Kotone Horikawa, Suzuyo Murakami

Abstract

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. We aim to incorporate the concept of “charge” into the real world, which is typically assumed in a virtual world interaction, and to achieve the sustainable development goals set out in the SDGs. In the first questionnaire, we asked, “What if you had to pay 5,000 yen at a time to achieve the SDGs?” In the second questionnaire, the amount of the money donated to attaining the goals was converted to a monthly amount, and the question “What if you were regularly charged to reach each target?” was asked as well as the question “To what degree you are interested in each target.” On the one hand, many eligible people have great interest in and willingness of being charged for “HEALTH” and “WATER.” On the other hand, they did not have interest in or willingness of being charged for “CLIMATE ACTION.” We would like to incorporate the concept of “charge” into the real world. To this end, it is necessary for us to focus on “HEALTH” and “WATER.” If we focus on “CLIMATE ACTION,” our effort will end up in failure.

Keywords: SDGs, environment, charge, WATER, HEALTH

Popularization of *Igo* Among Young People

Haruka Hikawa, Ken Morita, Kengo Taketani, Akise Taniguchi

Abstract

The number of *Igo* players in Japan has been constantly decreasing since 1982. In order to leave the game to the next generations, it is important to search for practical ways to make *Igo* popular among young people, most of whom hardly know the rules of the game. To obtain the information of *Igo*'s situation, we conducted a questionnaire about it for students of Rakuohku Senior and Junior High School. 27.1 percent of the students have played *Igo* or known its rules, and 56 percent of the *Igo* players got to know *Igo* when they were in elementary school. 72 percent of the students think *Igo* is difficult, 55 percent think of it as traditional, 66 percent think that its players are intelligent. 66 percent cannot judge whether *Igo* is enjoyable or not, 60 percent do not know it is conservative, and 57 percent do not think that it is for elderly people. These results show that students have enough opportunities to know *Igo*, and that whether they have played *Igo* or not, they do not enjoy *Igo* but do feel that *Igo* is difficult to play and that people who play *Igo* are wise. Therefore, the reason why *Igo* is not so popular among young people is that they cannot understand *Igo*'s attractive aspects when they first learn *Igo*. It would be important to create a simple way to explain *Igo*'s rules and let them know how attractive *Igo* is.

Keywords: *Igo*, popularization, young people, attraction, impression

Development of a Board Game for Natural Disasters

Kohei Higashitani, Kai Miura, Tamaki Yaga

Abstract

We conducted our research on the theme of making a board game to have people pay more attention to disaster prevention from childhood. We have refined our game by analyzing the characteristics of existing popular board games and repeating trials so as to make an enjoyable board game through which children can get the knowledge of disaster prevention efficiently. We designed this game in a way that it has more amusing elements, while reducing reality. This judgement is based on our expectations and experiences that it may take a long time to play a game with reality. Also, we made an enjoyable game so that our game becomes more accessible to those who want to play it. We came up with a rough model of the board game and included three essential elements: “rule,” “interaction,” and “dilemma.” In the future, we would like to meet our user’s demands and create a more exciting game.

***Keywords:* rule, interaction, dilemma, disaster prevention, board game, natural disaster**

Is Vegetarianism Really so Friendly Terms with the Environment?

Satoko Fukushima, Mayu Tomomitsu

Abstract

We heard that livestock raising has been seriously damaging the environment. Therefore, we assumed that a vegetable-based diet is something eco-friendly for the Earth. It is said that since vegans eat a particularly limited variety of foods, they care about the environment more than others. We examined the differences among vegans, vegetarians, and others in consciousness of the environment and what people think of vegetarianism by giving them a questionnaire. We sent it all over the world through the Internet. We also conducted an interview to two Dutch vegetarian researchers. As a result, we found that vegans are more conscious of the environmental damage that eating meat causes, while vegetarians focus more on saving animals or on their health. When it comes to the differences between them, vegans and vegetarians are rather more sensitive to those environmental problems. On the other hand, non-vegetarians are also trying to pay more attention to themselves by doing, for example, something that can help them save money.

***Keywords:* vegan, vegetarian, environment, livestock raising, health**

Relationship Between Groundwater and Wagashi - Comparison of Groundwater with Each Area in Kyoto

Hana Ishida, Mayuko Maekawa, Mao Nagata

Abstract

Kyoto is famous for its industries which depend a lot on water. We speculated that they are supported by rich and high-quality groundwater in Kyoto. Therefore, we focused on wagashi, Japanese traditional sweets, and considered the way that groundwater affects wagashi and the differences among areas in Kyoto. We visited wagashi shops in each area of Kyoto and did interviews and surveys. Also, we sampled the groundwater used there and examined the quality of the water. We made green tea agar jelly, using each water and tap water, and created a questionnaire survey about several items including hardness, color, and sweetness. As a result of these investigations, we found that the types of green tea agar jelly were influenced by the amount of ions contained in the water which was used in making the jelly. Besides, it was found that when the jelly was made from the groundwater, it had more flavor and green tea taste than when it was made from the tap water. In this research, therefore, it is concluded that the groundwater in Kyoto is the water that brings out the pleasant flavor of the ingredients in wagashi or the best water for making wagashi.

Keywords: groundwater, wagashi, Kyoto, water quality, tap water

Dilatancy

~The Measurement and Comparison of Viscosity Using Free Fall of an Iron Ball~

Yuka Matsumura, Mioko Murashima, Mako Shirai, Sota Takemori, Yugo Yamazaki

Abstract

Dilatant fluids usually behave like a liquid, but they behave like a solid when an impact is added. This property is mainly found in starch suspensions. An impact on the powder in its closest-packed state creates gaps among the particles, and water surrounding the surface of the particles enters the gaps. As a result, the volume of water covering the surface is reduced, and properties of a solid appear. We conducted two experiments using free fall of an iron ball in order to investigate the properties of dilatant fluids mixed with different powders and ultimately to construct a structural model of dilatant fluids. In the first experiment, to measure the strength of dilatancy, we used three kinds of powder which show dilatancy to some extent and made mixed fluids from two of these. Then, we poured them into plastic bottles and dropped an iron ball from the top of the bottle. In the second experiment, the basic steps of experiment were the same as those of experiment one, but this time we took a video of the observations and analyzed them to find a correlation between time and velocity of a falling iron ball. In the first round of our experiments, the mixture of 40g of corn starch and 10g of cassava starch showed the biggest property of dilatant fluids with measurement of 1.35s, 1.56s, and 1.46s, while the mixture of 25g of potato starch and 25g of corn starch showed the lowest with measurement of 0.20s, 0.25s, and 0.35s. In the second round of our experiments, the iron balls repeated the same acceleration and deceleration in the dilatant fluids. The first experiment's results indicate that two powders complement each other and compensate for their defects in case they are milled until they have become approximately the same size. If there is a big difference between two powders, the bigger one surrounds the smaller one and spoils the effect of the dilatancy. The second experiment's results indicate that the dilatant fluid's structure is like Mille-feuille structures containing solid layers and soft layers alternately.

Keywords: dilatant fluid, viscoelasticity, free fall of an iron ball, structure, powder

The Energy Storage System Using Small Rotating Bodies

Ryota Kamewaka, Kodai Mino, Shun Naito, Tomohiro Takamido

Abstract

In our present society, in which disasters frequently occur, taking effective measures against them is a matter of great urgency. When we have a power failure, an energy storage system that can be used at home is necessary because electricity is essential for our daily life. In our research, we spun rotating bodies with motors and measured the passage of time after electric energy supply stopped and the change of the frequency of generated electricity. We used three types of disks. One is the disk named DiskC, the weight outside of which was as heavy as that of the center. Another is the disk named DiskD, the weight outside of which was heavier than that of the center. The other is the disk named DiskE, which was heavier than DiskC and DiskD. Our results showed that the time of passage after stopping electric supply of DiskD was not longer than that of DiskC, but that of DiskE was longer than that of DiskC and DiskD. From these results, we found it difficult to make an energy storage system using a small rotating body. If we want to make the system practicable, we will have to use a heavier disk.

Keywords: disaster, power failure, energy, time, disk

Creating a Spatial Projection System Using Retroreflection

Eiji Horimoto, Mina Nishioka, Rona Brown, Yojiro Zushi

Abstract

The purpose of our study was to develop an easy way to make a three-dimensional projection of an object in the air. We found a product called “MIRAGE,” which makes an aerial image using a pair of spheroidal mirrors. By using its mechanism, we came up with a device which projects images in the air. We used a half-mirror and retroreflective sheets to create our device. As a result, the images we made were dark, slightly dim, and up-side down. Also, we conducted another experiment to observe the actual light path and found that there was a gap between incident light and reflected light on the retroreflective sheet. From the results of these two experiments, we concluded that we need to improve the way of reflecting the light in our device.

Keywords: retroreflection, “MIRAGE”, aerial image, half-mirror, light path

Arrangement of Two Points which Minimize the Maximum Distance Between Given Points in a Domain and Points P and Q

Shota Imai

Abstract

As for the math problem of PISA conducted in 2003, which asked the arrangement of point P that minimizes the maximum distance between P and X (X exists in domain D), I altered this condition in such a way that I extended point P into points P_1, P_2, \dots, P_n and considered the matter. I made my new original problem which is that “Consider a domain D of equilateral triangle with its length of a side being W. Find the arrangement of $\{P_n \mid n=1,2\}$ that minimizes $\max_{X \in D} d(X, P_n)$; the maximum distance between a given point X in D and $\{P_n \mid n=1,2\}$. Also, find the value of L which meets $L = \min_{P \in D} \max_{X \in D} d(X, P_n)$.” I made a hypothesis that as for P_1, P_2 , one corresponds with the middle point of one side of D, and the other corresponds with the vertex of opposite side of the one. To get a conclusion, I firstly sought the value of L, and considered covering D with two circles C_1 and C_2 whose diameter are both $2L$. Then, I found the arrangement of the two so that they completely cover the domain D. Finally, since the center points of them are equal to the arrangement of P_1, P_2 , I reached the very necessary and sufficient condition of it. To summarize, I got a conclusion when I set a domain of equilateral triangle and P_1 and P_2 , which means that $n = 2$.

Keywords: minimizing the maximum distance, arrangement, necessary and sufficient condition, equilateral triangle

The Conditions of a Unique Formation of Pieces in Ubongo

Ato Matsuda

Abstract

There is a game named Ubongo, which Kosmos, a German publishing company, released in 2005. It is a game that you can enjoy by competing with others in the speed of finding a way to lay pieces out on a board. However, the number of the ways to lay pieces out on a board is more than one in some combination of pieces and a board. I think that it makes Ubongo unfair. Therefore, I researched the conditions under which there is a unique formation of pieces in Ubongo. My hypothesis is that the larger number of lines are neighboring each other, the more convex shapes there are on a board, and the larger value the length of circumference of a board minus the number of squares is, the more likely you are to find a unique way to lay pieces out on a board. I lay pieces out on a board, and I checked the conditions that make the way to lay them out on a board unique. The result showed that when the number of lines that are neighboring each other is eight, the way to lay pieces out on a board is most likely to be unique. I found that the most important condition is that the length of the lines neighboring each other is longer. I also checked the case in which I used the board that I made by myself, but I could not find out crucial conditions clearly.

***Keywords:* unique, convex, neighboring, number of squares, circumference of a board**

Relation Between Joker's Initial Position and the Odds in Old Maid

Taiyo Kitayama

Abstract

I calculated the probability of a model which simplifies Old Maid, a card game called “baba-nuki” in Japanese, in order to specify the relationship between the initial position of a Joker and the winning rate. I made a hypothesis that the person who has a Joker at first has the lowest winning rate. When it comes to calculation, first of all, I investigated the case of three people by using a graph which shows the ratio of the number of each person's hand under the conditions which I set. Next, I calculated the number of cards in each lap and generalized it and then I generalized the probability of N people. From the results of the calculation, I got the probability of generalized people and reached the conclusion that the person who has a Joker at first has the highest winning rate in this case. However, when I calculated the total rate, it exceeded one. I couldn't elucidate the mystery. These results indicate that I calculated the simplified probability but that I didn't calculate the probability which removes the conditions that I set.

Keywords: odds, Old Maid, probability, Joker, winning rate, hand

The Locus of the Triangle Center When Moving One Vertex of a Triangle

Yuto Yagi

Abstract

I thought that if the locus of the triangle center can always be obtained in a certain way, there may be some regularity or relationship in the trajectory. When I set the two vertices of a triangle and moved the other one on various straight lines, I looked at the trajectory of the triangle and what the relationship was like by using GeoGebra and Mathematica, mathematical software. Due to the apparent correlation between the inner center and the excenter, the result suggests that there may be a correlation between the inner center, the excenter and the gravity center that have been proved to be aligned in a straight line on the Euler line. Since only the case of moving the gravity center and the vertical center on the various straight lines has been investigated, this should be examined at all five points, and this should be extended by moving point C not only on a straight line but also on a circle or a quadratic function. I want to find out what trajectory is drawn.

Keywords: vertex, correlation, inner center, excenter, gravity center, Euler line