TOWARDS INCREASING
STUDENTS' SCIENTIFIC KNOWLEDGE AND INTEREST

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Abstract : The Super Science Course has (SSC) been aiming at the development of education to cultivate scientists working in the international scene. Especially the main challenge is the implementation of RSSF and approach to science project research. The several challenges, for example, the formation of high scholastic ability of math and science, the support of participating in international science Olympics, the enhancement of the daily learning project 'Math Seminar' etc, are very effective in motivating students to learn independently and improve academic skills. Also high level English proficiency and development of the ability to communicate is an important premise. In SSC the students can get world-class and high-level science, mathematics ability. The students can experience learning in university from high school and find their own research themes. In addition they can get a wide view through exchanges with overseas students and expand their future goals. It is important to gain the basic academic skills to promote scientific interest and increase the spirit of exploration. We have achieved great success in the following fields: the internationalization of scientific education and production of world-class scientists. Especially with the scale of RSSF continuing to increase each year we can create a world-wide network which leads to increasing student motivation. It is to our great pleasure that students have won several awards and did their research with fantastic results. In this presentation I'll introduce the following four points: the outline of Ritsumeikan High School, the education of SSC, the approach to mathematics education and achievements.

Keywords : Global, Research, Collabolation

CHAPTER 1
THE EDUCATION OF RITSUMEIKAN HIGH SCHOOL

Ritsumeikan High School was founded in 1905 on the principles of freedom and innovation. The spirit of living life to the fullest through academics has been handed down throughout Ritsumeikan's history of over 100 years. In this chapter I'll briefly explain the outline of our school.

1-1. THE OUTLINE OF RITSUMEIKAN HIGH SCHOOL

Ritsumeikan is one of the biggest and oldest private educational institutions in Japan, consisting of 2 universities with 4 campuses, 4 junior and senior high schools and one primary school, and is celebrating its 110th anniversary. Ritsumeikan's founding ideals are "Freedom and Innovation". Our emphasis is to create new ideas and make something new independently. Another core educational philosophy is "Peace and Democracy", reflecting the wartime experience after World War II.

We also highlight the idea "To believe in the future, to live for the future". Having this philosophy, we facilitate students acquiring strong bases for higher education, contributing to the development of our society and

fostering leaders to society for the globalized, information intensive society of 21st century.

Ritsumeikan Junior and Senior High School is located in Kyoto, Japan, and is Ritsumeikan‘s eldest affiliated school at 105 years old. The total number of students is 1654. The numbers in Junior High School and Senior High School are 662 and 992 respectively. We have increased the number of homerooms of the first year of Junior High School from 6 to 8 classes this past year. To accommodate for better learning strategies, we have decreased the homeroom class size from 36 to 30 students.

1-2. COLLABORATION WITH RITSUMEIKAN UNIVERSITY

Ritsumeikan High School is an affiliated school. We take advantage of this to make collaborative curricula with Ritsumeikan university using facilities in the university. We provide quality educational programs that promote life-long learning and strong values in leadership and academic excellence in the science field that will contribute to the development of our society.

We have a satellite campus in Biwako Kusatsu Campas (BKC) [1]of Ritsumeikan University, which is for the Super Science Course students. The first and second year students go there twice, while the third year students go three times a week. They take science and mathematics classes, and do research for advanced projects. All of the Super Science Course students carry out their research in every scientific field. They can use University facilities and get advice from professors.

CHAPTER 2
THE EDUCATION IN SUPER SCIENCE COURSE

In the Super Science Course the students can get world-class and high-level science, mathematics ability. The students can experience learning in university from high school and find their own research theme. In addition they can get a wide view through exchanges with overseas students and expand their future goals.

2-1. THE AIM IN THE SUPER SCIENCE COURSE

In 2002, our school was designated a Super Science High School by the Ministry of Education, Culture, Sports, Science and Technology. Then we made a special course to promote the science education, called the Super Science Course. One out of the nine classes in each grade in high school is taking this course. We continue to explore and improve upon our science and mathematics programs.

Ritsumeikan High School has been a pioneer in science education for secondary schools. One of our most important developments has been to regularly send students overseas to participate in science fairs and exchange programs. These trips give our students opportunities to learn from the wonderful research that foreign students have produced and the importance of science education in other countries.

We take great pleasure from witnessing the tenacious effort and intelligence of the students to achieve their goals and to overcome cross-cultural barriers.

2-2. SCIENCE WORKSHOPS

We have Science workshop programs with institutions such as

[1] One of three campus comprising Ritsumeikan University, BKC also plays host to Ritsumeikan High School students in a dedicated facility as part of the Super Science High School program.

- The National Museum of Emerging Science and Innovation (Miraikan),
- National Institutes of Natural Sciences (NINS)
- National Institute for Fusion Science (NIFS)
- SPring-8[2], a large synchrotron radiation facility which delivers the most powerful synchrotron radiation currently available.

Workshops are conducted as follows;

- The institution gives students some themes, students experiment or investigate the theme.
- They discuss and make conclusions, and then they make presentations and discuss again.
- Students develop their skills and improve their interests through workshops.

I'll explain in more detail about the NINS workshop. Last year we had a workshop with the students of Mahidol, Thailand. On the first day, we visited the National Institutes of Natural Sciences in Okazaki City, Aichi Prefecture. We practiced using muscle sensors and visited the Ultraviolet Synchrotron Orbital Radiation Facility (UVSOR), and the Plant Culture Laboratory within the following three laboratories: Physiological Sciences, the National Institute for Molecular Science, and Basic Biology. Then we went to the Aichi Prefectural Youth House and the students divided into 10 groups and organized what they learned. In the morning of Day 2, each group did the presentations about their learning point and did the question and answers. Each group put together their unique views with Mahidols' students and made good presentations by using several forms of media, photos and movies.

2-3. INTERNATIONAL EXCHANGE PROGRAM

We emphasize the importance of international exchange programs. Many programs are held for students. A student will go abroad at least once a year to participate in an exchange program, a science fair or a workshop.

These international events and programs provide motivation for students to research. To know the high level of research conducted by overseas students helps to raise the level of our students' research. It also enhances the student's English communication ability and event management skills and allows them to create networks for the future. Now I'll introduce the main programs for this year.

< Sending >

- Canada Manitoba Fort Richmond College (Workshop)
- Australian Science and Mathematics School (International Student Science Fair)
- UK Camborne Science & Community College (Workshop)
- Thailand Mahidol Wittayanusorn School (Short Exchange Program)
- Canada Manitoba Bio Innovation Week (Workshop)
- Taiwan High Scope Program (Symposium)
- Korea Science Academy of KAIST (Short Exchange Program)
- Hawaii Science Workshop (Workshop)
- Singapore International Mathematics Challenge 2010 (Competition)

< Hosting >

- Thailand Mahidol Wittayanusorn School (Short Exchange Program)

[2] The name "SPring-8" is derived from "Super Photon ring-8 GeV" (8 GeV, or 8 giga electron volts, being the power output of the ring.)

- Korea Science Academy of KAIST (Short Exchange Program)
- 7th Rits Super Science Fair (Science Fair)

I'll describe the programs of the Hawaii Science Workshop. The program is assorted into four main themes: earth science based mainly on volcanoes and geology, astronomy based on the observations of stars, biological acoustics based on the research of marine life and sound, and robotics. Each program takes advantage of Hawaii's landscape and location.

Program 1: Earth Science

We heard an explanation about the volcanic activity in Jaggar Museum and Observatory and had a hike in Kilauea Iki Crater. We went through lava tunnels, and walked on the trail made by solidified lava in the smoking volcano. We observed lava trails with red-hot lava and were overwhelmed by the forces of nature. We simulated a magma eruption with gelatin at The University of Hawaii.

Program 2: Astronomy

The Subaru Telescope is an 8.2-meter optical-infrared telescope of the National Astronomical Observatory of Japan, located at the Mauna Kea Observatory in Hawaii. After the explanation about the Subaru Telescope, we monitored the state of the summit through a display connected with the summit of Mauna Kea. We also climbed up two hills located on the hillside of Mauna Kea. With a beautiful view looking over the clouds, we watched a gorgeous sunset and enjoyed a crystal clear view of the star-filled night sky.

Program 3: Bioacoustics

Bioacoustics is studied at the Hawaii Institute of Marine Biology (HIMB) located on Coconut Island in Kane'ohe Bay. Surrounded by water, we first gathered seaweed. Then, from that seaweed, we extracted and separated out various marine creatures, such as the snapping shrimp. The snapping shrimp uses its claws to make a loud snapping noise. By putting the snapping shrimp together with other marine life, we could make it "snap" its claws and collect the data. We then ran an experiment digitalizing and analyzing the audio data.

Program 4: Robotics

We practiced with Letry Robots and VEX at Waiakea High School and LEGO robotics at Iolani High School, a total of 3 kinds of robots. The Letry Robot is an educational robot that uses various sensors, etc. We built a robot that ran if it detected sound. The students had to use their voice to power the robot in a race. We also used VEX robotics to play a tournament-style game in a "field" where the robots picked up balls and placed them in designated areas. All robot construction was done by the students, from the conception and design to actually screwing the parts together. At Iolani we heard an explanation about LEGO robots and then actually made them ourselves and had them play in a simple game.

FIGURE 1

Hawaii Science Workshop

2-4. RITS SUPER SCIENCE FAIR

The Rits Super Science Fair (RSSF) is held every year by Ritsumeikan High School. It is an opportunity for Senior High School students from many countries around the world to think about global issues together and establish networks for future cooperative research and action. The RSSF is not a science presentation contest, but a chance to share experiences and research with overseas students. All programs are delivered in English. We have this fair every year and students learn and make their project research in English.

TABLE 1

RSSF2010 Itinerary

Day	Time	Eents
DAY1	AM	Opening Ceremony, Special Lecture
	PM	BBQ Party, Science Zone Lecture, Project Poster Exhibition
DAY2	AM	Science Project Presentation
	PM	Science World, Science Zone
DAY3	AM	Science Project Presentations
	PM	Science Zone, Science Zone Presentation
DAY4	AM	Industrial Tour
	PM	Sight Seeing, Dinner / Shopping, Dinner Party
DAY5	AM	Project Poster Exhibition
	PM	Introduction to Japanese Culture , Cultural Performance, Closing Ceremony

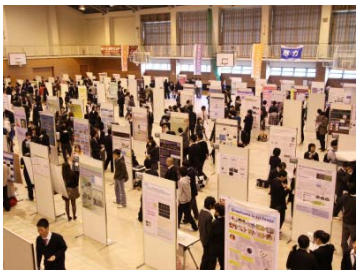
Through this fair, Ritsumeikan High School is aiming to be a global center of science education. The number of participant schools in the RSSF 2010, was 31 from overseas and 15 from Japan. Participants enjoyed exchanges through their presentations on science projects and research, workshops and industrial tours. The main events are as follows.

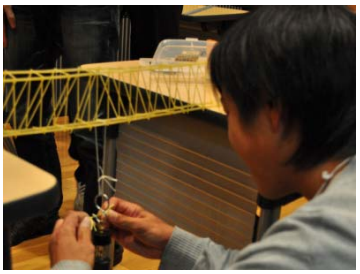
2-4-1. Science Project Presentations

Participants present research at several venues. Presenters talk about their own papers or reports. Every year there are many interesting and enlightening presentations by high school students. Students exchange their research and ideas with other participants including teachers and professors, so that it is a fruitful time for everyone.

FIGURE 2

Rits Super Science Fair



2-4-2. Project Poster Exhibition

Participants present their research in a poster on two days. Presenters talk about their own research in

front of their own project posters and share their findings with the audience. The posters are always creative and unique. The numbers of posters by category last year were as follows.

Mathematics 16, Physics 31, Earth Science 4, Chemistry 23, The Environment 17

Biology 44, Others 12, Introduction to Ritsumeikan 24, Introduction to Japan 51,

Alltogether there were 222 posters last year.

2-4-3. Science Zone

Science zone is a mini-workshop, which encourages international collaboration on scientific topics. There are six different science zones. Participants will be divided into groups. Each group will be given an assignment on which to work together. Last year, we provided 6 zones as below.

TABLE 2

RSSF2010 Science Zone

Zone	Contents
Energy Zone	Solar Boat
Construction Zone	Spaghetti Bridge
Design Zone	Scale Model Test
Scanning Zone	Medical Imaging
Robot Zone	LEYry Robots
Math Zone	Math Challenge!!

2-4-4. Science World

Science world is an interactive lecture on several special topics given by university professors and teachers from the visiting schools. Last year, we provided 7 topics as below.

- Game Software Development
- What are Dark Matter and Dark Energy? -The facts that observations have revealed-
- Can Robot be Social?
- Haptic collaborative virtual environment with ultra-realistic communication technologies
- Welcome to the “Science World” of sports and health!
- Science is Fun!
- Be a Science Communicator!

Through this event, the students gain interest in science and an introduction to exciting and new fields.

2-5. APPROACH TO SCIENCE PROJECT RESEARCH

At our school in the super science course, we devote one hour per week, apart from normal science courses, solely to the approach to scientific research in the 10th grade and two hours per week in the 12th grade. Also, in the 11th grade, we develop the students’ scientific research skills through the subject, Life Science, and an introductory course to cutting edge science in collaboration with the university. In the 10th grade course, Science Research, three science teachers instruct the students on the fundamentals of experimentation, how to arrange reports and how to make presentations. For example, in a physics experiment, they learn how to gather and analyze data collected using Easy Sense.

TABLE 3

SSC Science Project Research

Grade	Approach
10th grade	Science Research (1 credit)
11th grade	Introduction to Cutting Edge Science (2 credit), Life Science (original text, 2 credit)
12th grade	Science Research (2 credit), Thesis Guidance, Participation in Contests

Here is a list containing the content of last year's "Introduction to Cutting Edge Science" course with the university.

TABLE 4

Introduction to Cutting Edge Science

Class	Theme
Introduction to Environmental Engineering	Recycle-oriented Society, Water Purification Technology using Microorganisms, Basin Zone Management, Air Pollution
Introduction to City System Engineering	Urban Transportation, Earthquake-resistant Construction
Special Lecture	VLSI[3] and the future, Modern Robotics
Frontiers of Information Science and Engineering	Search Mechanisms, Introduction to Quantum Cryptography, Multi-Agent System, Ultra-mobile Computing and Ubiquitous Computing, Introduction to Intelligent Computing, Computer Vision, Stop Motion Animation, Stop Motion Movies, Computer Graphics

The most important aspect of science research is the research theme. We must consider how to create and develop scientific interest within the students. Because the students can't research highly advanced, difficult topics, we believe the research theme should be something that is familiar to the students and also at a level which they can work with.

CHAPTER 3
THE APPROACH TO MATHEMATICS EDUCATION

Certainly, everyday basic learning is fundamental to increasing students' scientific literacy. It is important to gain the basic academic skills to promote scientific interest and increase the spirit of exploration. In this chapter, I'll introduce the efforts to increase the student's interest in mathematics education.

3-1. 'Math Festa' OPPORTUNITY TO PRESENT THEIR SUMMER ASSIGNMENT

We have students make a report every summer about mathematics. The report must be over 5 pages. Our goals for the reports are that they be creative and include original content. Many reports are somewhat superficial, but some reports are unique and have originality.

From here we held our 'Math Festa' where excellent students present their reports for 15 minutes. Here are some themes from the last 'Math Festa'.

[3] Very Large Scale Integration

- The Mystery of Kaleidoscopes
- Damage Caused by Earthquakes on Slopes
- Analysis of Chladni's Figures
- Cutting and Combining Polyhedrons and Filling Space Using Origami
- A Study of Repeating Decimals of 1/m in base-n

"Math Festa" has a positive effect on the students, boosting their motivation for subsequent projects. It has become the gateway to domestic and overseas presentations. Providing the students with an opportunity to present their research is very important and crucial to their further development.

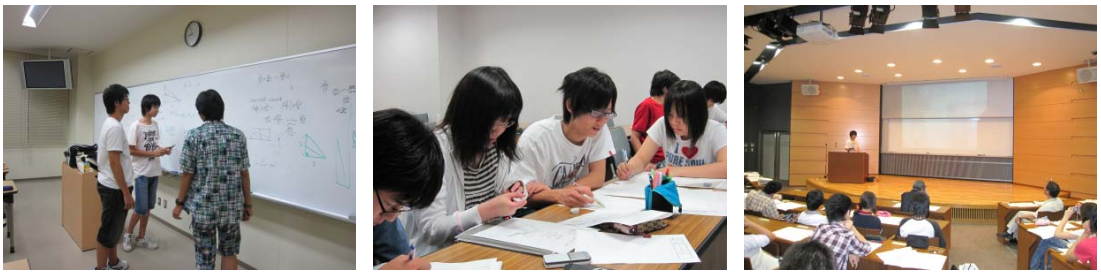
3-2. SPECIAL MATHEMATICS PROJECT 'Math Seminar'

We have held the 'Math Seminar' for several years where students stay overnight in order to solve interesting and challenging problems. We plan on doing this project three times this year and have over 30 students take part every time. First we have an ice-breaking project and after that the students are divided into groups of 3-4 students and work on 10 problems.

The students solve the problems in classrooms until about 10:30 pm and then continue solving problems until about 1:30 am at an accommodation which is in the same campus. The next morning we select the groups to present each problem and then the designated group presents how to solve the problem. Lastly the teachers comment on their work and recognize their efforts by presenting them with awards, in praise of their hard work.

FIGURE 3

Math Seminar



The aim of this project is to develop and cultivate the students' math skills obtained in the classroom, as well as promoting cooperation in study and research with collaboration among all grades. This project has been fun for the students.

If some students are poor at mathematics, their interest and enthusiasm for mathematics is aroused by the help and instruction from others in the group and working cooperatively in a team.

3-3. PROMPTING INTERNATIONALIZATION WITH 'Math Zone'

There is an activity, 'Science Zone', in the Rits Super Science Fair. In these Science Zones, the participants are split into some groups and perform activities. One of these science zones is the "Math Zone", a competition to solve mathematics problems. It could be called the international version of the "Math Seminar" mentioned before.

Last year, Math Zone was held for three days. On the first day, the teacher explained the problems and the students got into groups of three or four students and began working on four math problems. The questions

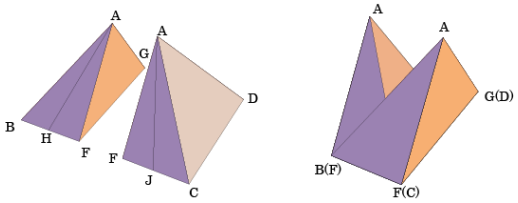
are from a wide range of topics from computational problems to problems which test their analytical skills. However, none of the problems require knowledge of advanced mathematics. At the end of the second day, they must hand in their answers. On the last day, the groups selected by teachers do presentations and explain their answers to the problems.

FIGURE 4

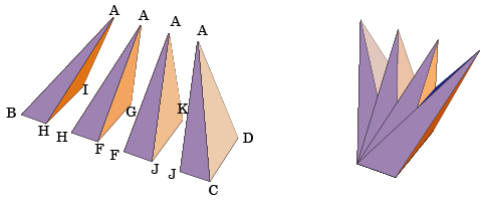
One of the Questions of 'Math Zone'

Answer the following problems regarding the regular pyramid A-BCDE with a square base, with sides of length a, and equilateral triangles, with sides of length a, for the sides.

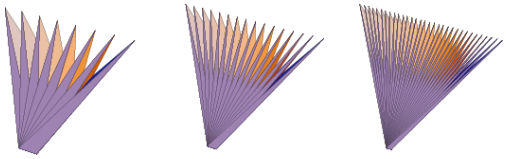
(1) Let F be the midpoint of BC, and G be the midpoint of DE. Divide the pyramid into two by cutting along the triangle AFG. Shift the two parts so that their bases coincide. Find the volume of the combined solid.



(2) Next divide each of the two parts from part (1) into two parts by cutting along the triangles AHI and AJK, where H, I, J, K are the midpoints of BF, GE, FC, and GD respectively. Shift the parts so that their bases are coincide. Find the volume of the combined solid.



(3) Continue this process n times, thereby creating 2^n parts and shifting their bases to coincide with each other and find the volume of the combined solid. If you were to continue this process ad infinitum, what would the volume of the resulting solid be?



Last year, the students became very involved and excited with the presentation, leaving little time for the teachers to give their explanation and sample answers. It was interesting to see the different ways people from different countries wrote their formulas and the difference in ideas and viewpoints. Here is one of the questions the students worked on during last year's 'Math Zone'.

3-4. SPECIAL MATHEMATICS LECTURE

A special mathematics lecture is held a few times a year. In the lecture, the students learn mathematical content which is not covered in their textbooks. The workshops are designed to allow the students to get a deep understanding of the content through given tasks. Here are some concrete examples from this workshop.

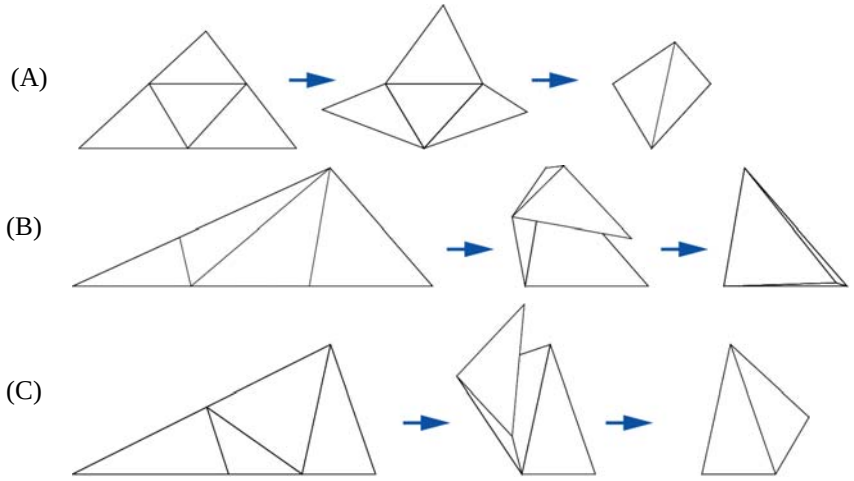
Example 1: Finding the condition for making a regular polyhedron from one triangle

Students quickly realize the way of folding a triangle into a tetrahedron like Figure5 (A). Then, let the

students think theoretically about other solutions from the viewpoint of the number of points and matched edges. There are two cases like Figure5 (B & C) but sometime we can't make a tetrahedron according to the length of the side and the angle. So we let the students think about the condition for existence.

FIGURE 5

Making a Regular Polyhedron from one Triangle

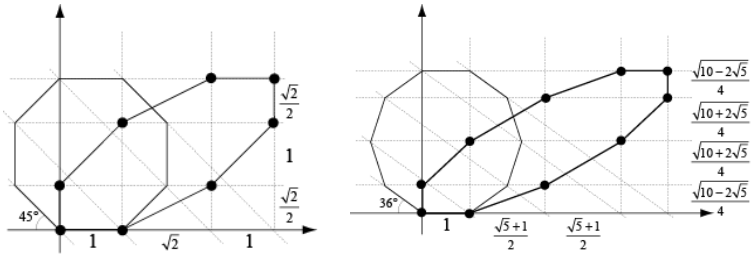


Example 2: Balance Coefficients, Vector Problems solved by Polygon Transformations, and Games by Connecting Vectors

By using two nonparallel basis vectors obtained by connecting two vertices of a regular polygon, any vector connecting two vertices of the polygon can be expressed as a linear combination of the two basis vectors. By shearing the polygon we can express the linear combination easily.

FIGURE 6

Polygon Transformations

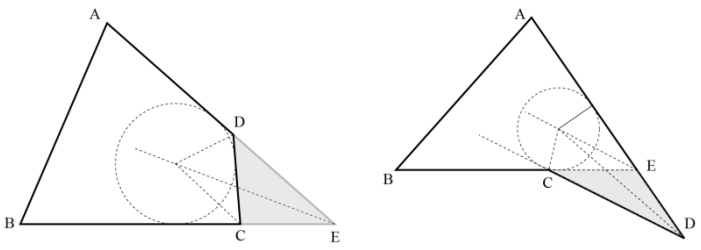


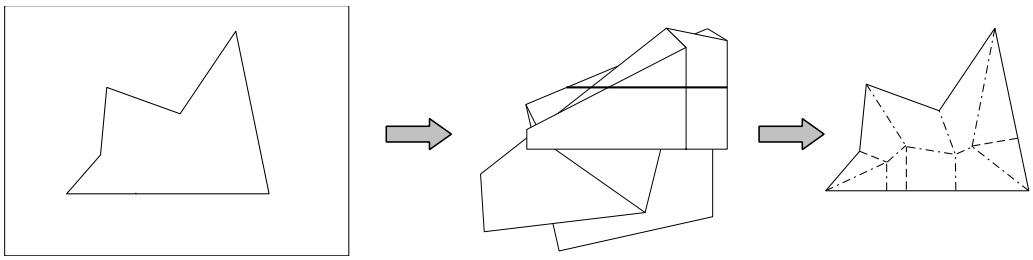
Example 3: Exploring the Properties of the Five Triangle Centers through Origami and Overlapping Sides of Polygons.

We can fold a polygon so that all sides overlap by using the property of the incenter and the excenter of a triangle. The students learn this theorem practically by folding Origami

FIGURE 7

All Sides Overlap



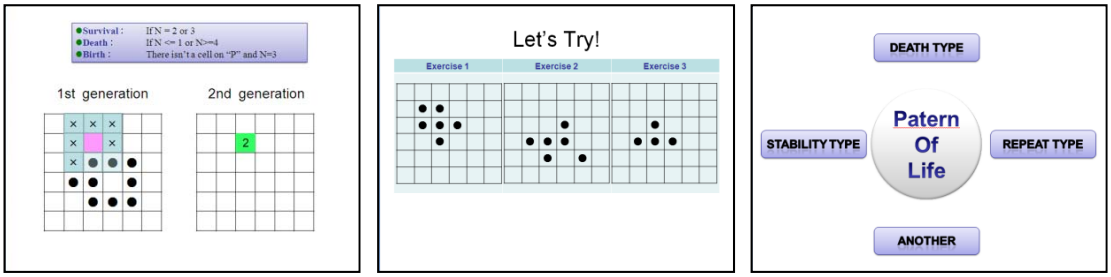


Example 4: The Game of Life

The Game of Life is a simulation game which was devised by John Horton Conway, a mathematician, at Cambridge University, in 1970. It is a representation of the biological society. After teaching the rules of the Game of Life we let the students answer some questions and find the patterns.

FIGURE 8

The Life Game



Example 5: Fractals and Chaos

After learning the recursive figures such as the Koch curve and the Tree curve, let the students learn the image created by a linear recurrence formula by using a computer. Then, expanding to non-linear recurrence formulas, the students learn about chaotic regions.

3-5. THE POSITIVE USE OF FREE SOFTWARE FOR MATHEMATICS

There exists a number of good and convenient free software for mathematics. In particular, the function graphing software, GRAPES, is a high quality program known for being lightweight and comprehensive. 'GRAPES' allows you to draw the graphs and the loci of most of the functions which appear in the upper secondary school curriculum, and to analyze them from diverse aspects. So this software is designed to be easy for beginners. The main features are as below;

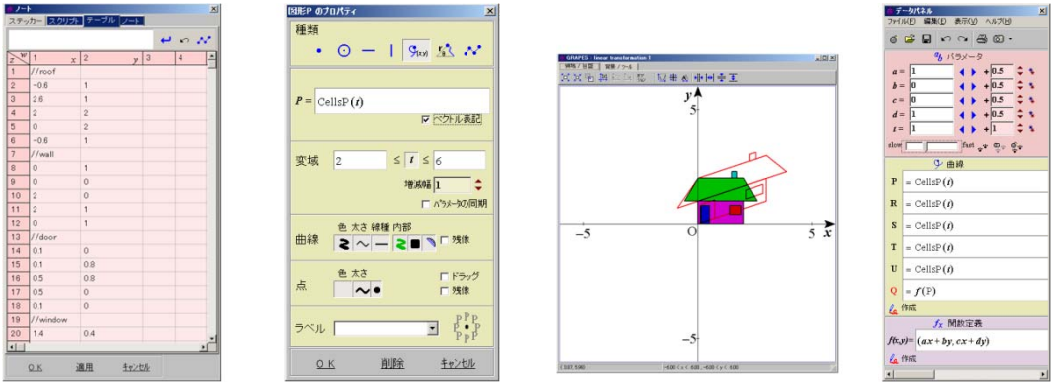
- Drawing various graphs
  (Graph of function, Graph of relation, Region defined by inequalities, Parametric curve, Graph of polar equation, Circle, point, segment, polygon, line, vector, rectangle)
- The graphs of most of the functions encountered at the high school level can be drawn .
- You can move a graph in real time by increasing or decreasing of parameters and dragging points.
- You can process simple programs by using script.
- There are some tools for analyzing graphs.
  (Zoom in or out, and displacing graphs. Function value and definite integral windows. Showing expression and coordinates with the cursor.)

This year, I used the software to make teaching materials to explain linear transformations by transforming concrete images, Fourier series analysis by adding or decomposing into sine and cosine curves, and more.

For the teaching material of linear transformations the students input data and draw figures by using ‘GRAPES’ and they examine how the figure transforms by changing the matrix parameters.

FIGURE 9

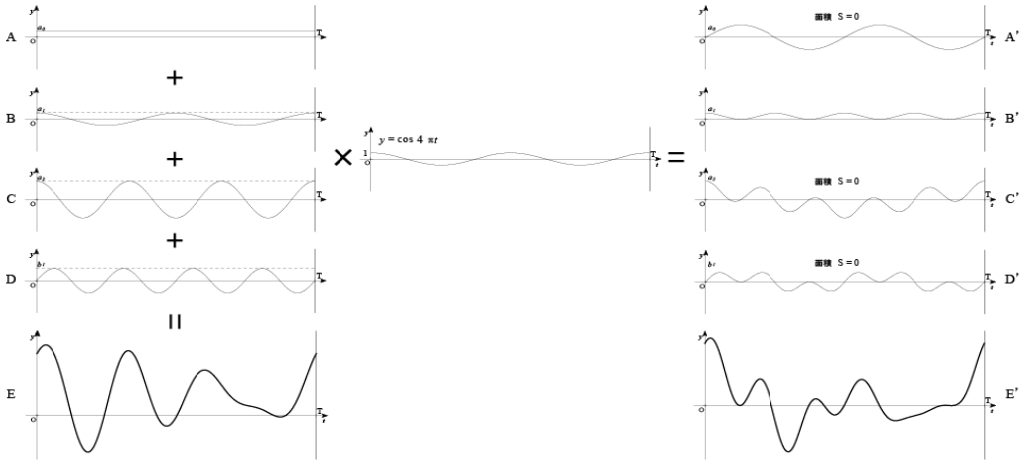
Linear Transformations by Transforming Concrete Images



When learning Fourier Series, the students first consider the relation between curves and frequency. Then I made the students examine the relation to area. For this, we use a feature of ‘GRAPES’ to calculate the area.

FIGURE 10

Fourier Series



Because this software has been translated into some languages including English, I would like you to try it. (Function Graphing Software GRAPES, http://www.criced.tsukuba.ac.jp/grapes/)

3-6. PUBLICATION ON THE WEBSITE ‘Spring of Mathematics’

I publish the teaching material on the website as much as possible. This is because by making the data public and compiling it in one place not only makes more data available, but also leads to the creation of new networks for mathematics education. On the website, ‘Spring of Math’ (http://izumi-math.jp), many mathematics teachers send information about mathematics education and practical. For example, the following topics are born from the students’ questions.

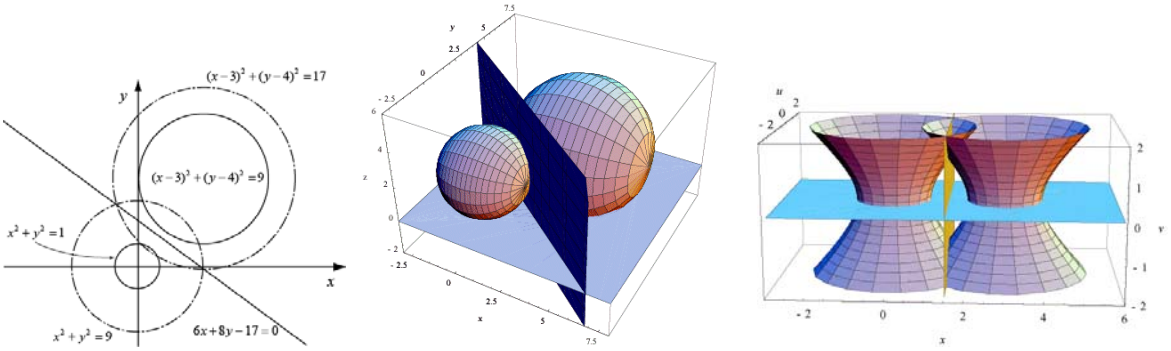
The equation of the line passing through the intersection of two circles is determined by subtracting the two equations of the two circles. But if the two circles don’t intersect each other, we can get an equation by subtracting the two equations. What does the equation mean?

Several interpretations on this theme have been made, such as the locus of points as the ratio of

powers, a curve formed by the intersection of sphere and the xy-plane and so on. We can also expand the xy-plain into complex space and show the existence of a line as the projection of the intersection of the complex surfaces.

FIGURE 11

Projection Line



In particular, my website ‘Casket of Mathematics’, one of the pages on the websites, has several topics about mathematics. I describe the topics in a plain and comprehensible manner. I sort the contents into fields and cover interesting topics not found in the school textbooks. I’ve already compiled over 200 topics and introduced them as deeply and compactly as possible. If the students have an interest, they can examine more for themselves. I give this site the role of a navigator. This site could be called my lifework.

CHAPTER 4
ACHIEVEMENTS

The Super Science Course has been aiming at the development of education to cultivate scientists working in the international scene. In this report I’ve briefly shown that idea. Especially the main challenge is the implementation of RSSF and approach to science project research. The several challenges, for example, the formation of high scholastic ability of math and science, the support of participating in international science Olympics, the enhancement of the daily learning project ‘Math Seminar’ etc, are very effective in motivating students to learn independently and improve academic skills. Also, of course, high level English proficiency and development of the ability to communicate is an important premise. I’ll introduce the achievements in the following three points.

4-1. EXPANSION OF RITS SUPER SCIENCE FAIR

Rits Super Science Fair (RSSF) is a venue at which young scientists can meet and interact with their fellow students, not in the sprint of competition, but in the interests of learning from each other and building a wide network that they can exploit in their global futures. With the scale of the fair continuing to increase each year, and the content also broadening and deepening, last year, we had our 8th annual RSSF.

As young scientists this is a hugely significant chance to take in the scope and wonder of science as well as to develop the necessary experiences and international networks that will support the students’ futures. I can only attribute the great success of this fair to the similarly overwhelming level of support received from people across the country working towards the advancement of science and technology.

TABLE 5

RSSF Participants

RSSF	Year	Overseas Schools	Domestic Schools
1st	2003	1 school 8 participants from 1 country	2 schools
2nd	2004	2 schools 10 participants from 2 countries	3 schools
3rd	2005	9 schools 33 participants from 7 countries	6 schools
4th	2006	12 schools 65 participants from 9 countries, regions	6 schools
5th	2007	15 schools 99 participants from 10 countries, regions	7 schools
6th	2008	32 schools 192 participants from 16 countries, regions	8 schools
7th	2009	25 schools 108 participants from 14 countries, regions	9 schools
8th	2010	31 schools 119 participants from 18 countries, regions	15 schools

4-2. SUCCESS IN INTERNATIONAL SCIENCE CONTESTS

In order to cultivate an international viewpoint in the students, we find it very important for them to take part in international science contests. It is clear that these high-level and intense competitions raise our students' levels. At our school, we have, in the past, three times received high awards at the Japan Science and Engineering Challenge (JSEC) and the eligibility to participate in the International Science and Engineering Fair (ISEF). Notably, in this year's JSEC, we were awarded the nation's highest award, the Minister of Education Award. Advancement to ISEF in May has been decided and we are continuing instruction with great expectations.

The topic of the research that won the award was "Cutting and Combining Polyhedrons and Filling Space Using Origami." One of the judges commented, "This research combines art and origami. It is a little rough around the edges, but there may be a mathematician who takes this up and further develops this research."

FIGURE 12

Japan Science and Engineering Challenge

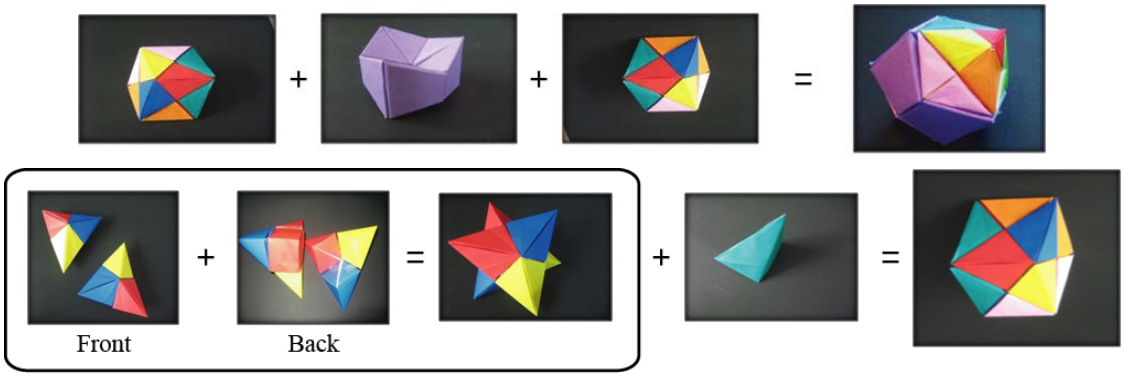
Here is the abstract for the research for your consideration.

We examined the cuts and divisions of polyhedrons and their rearrangements into new shapes which have no empty space inside. This was done using origami to represent the pieces of the polyhedron, so we had to also consider the different folds required to create the pieces. There are three ways to make a solid which can fill up space. They are Dividing, Cutting and Combining.
In this research, dividing means to divide a solid into many parts which share vertices and diagonal lines from the original solid and cutting means making cuts at arbitrary places. So we can make various solids using cutting.

FIGURE 13

Dodecahedron Made from Diamond-Shaped and Trapezoidal Origami

How to Make a Parallelepiped



4-3. THE REALIZATION OF A FRUITFUL COLLABORATION BETWEEN SECONDARY EDUCATION AND UNIVERSITY

The collaboration between high school and university at Ritsumeikan has become a great success. With the introductory course on cutting edge science in 11th grade and the university lessons for 12th graders, we have been successful in increasing the student' interest in science. Last year, we had the class for introductory cutting-edge science 17 times. By taking classes with more advanced viewpoints, it truly serves as a foundation for their future research. Also, the students are very passionate when taking courses in science, math, etc, at the university.

In physics, we have put into practice "collaboration classes" with university professors. In addition, we hold practical classes in the summer vacation aimed at high school students involving the synchrotron center, and VLSI (Very Large Scale Integration) production, as well as various other collaborative projects with university.