

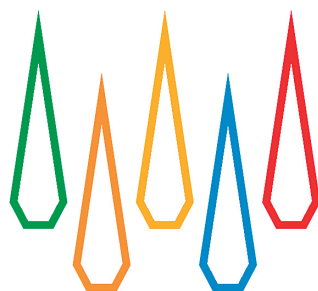


The 53rd *Remote*
ICHO 2021
Japan

Report

The 53rd International Chemistry Olympiad (ICHO) 2021 Japan
Organizing Committee





ICHO

Remote
The 53rd IChO 2021 Japan
Report

Printed on April 21, 2022 in Japan

Published by The 53rd International Chemistry Olympiad (ICHO) 2021 Japan
Organizing Committee

Produced by The 53rd International Chemistry Olympiad (ICHO) 2021 Japan
Secretariat Office

Edited & DTP & Printed by MITSUBA TOTAL PRINTING CO.,LTD.

**This report is also uploaded on the website of The 53rd IChO 2021 Japan.
(<https://www.icho2021.org/>)**

The 53rd IChO 2021 Japan

Report

Table of Contents

Message	1
President of IChO 2021 Japan Committee Chair of the 53rd IChO 2021 Japan Organizing Committee Kohei Tamao	
Overview	4
Member of the Steering Committee Member of the 53rd IChO 2021 Japan Organizing Committee Vice Chair of Science Committee Vice Chair of Executive Committee Kanagawa University, Professor Nobuhiro Kihara	
National Team of Countries	11
Results	55
Certificate and Medals	71
Memento and Gifts	75
IChO 2021 Japan Photo Collection	78
Examination	83
Examination Guideline	85
Problem English Version with Solution	99
Reference : Practical Tasks	177
Catalyzer	197
IChO 2021 Japan Pre-event	256
Committee	258
Acknowledgments to Donations	271
Special Thanks to Various Contributions	275



Message



Kohei Tamao

President of IChO 2021 Japan Committee
Chair of the 53rd IChO 2021 Japan Organizing Committee

The 53rd International Chemistry Olympiad, IChO 2021 Japan, was held remotely from July 25 to August 2, 2021, under the slogan “Chemistry! It’s Cool!”.

Originally, we had been preparing to hold IChO 2021 Japan at Kindai University, one of the biggest private universities in Japan, located in the lively and modern commercial city of Osaka in mid-west Japan, also known as the historically important birthplace of chemical research in this country.

However, in light of the ongoing COVID-19 pandemic, we had no choice but to hold IChO 2021 remotely, following the lead of IChO 2020 Turkey last year.

This was the result of giving top priority to the safety of our young talented students and all participants, even at the expense of practical examinations and opportunities for in-person international exchange. I would like to thank all the International Steering Committee members led by Dr. Gábor Magyarfalvi for their enthusiastic discussion and acceptance of our decision.

The purpose of the IChO is not only to provide a venue for a test of students’ chemistry skills, but also to foster communication among students through chemistry and to gain familiarity with the culture of the host country. Despite being a remote competition held under the difficult conditions presented by the COVID-19 pandemic, the question of how to effectively implement these three elements was our biggest challenge.

The key dates were as follows:

July 25 (Sunday): Opening Ceremony

July 28 (Wednesday): Theory Examination

August 2 (Monday): Closing Ceremony

On other days, we offered various initiatives for students to create international friendships and become familiar with Japanese culture, in addition to the challenges of the scientific competition. We also provided a demonstration video of the practical tasks to compensate for the fact that the practical examinations could not be held. Virtual reality avatars for all students were prepared to facilitate remote networking and to give greater realism to virtual participation in the realistic Opening and Closing Ceremonies and virtual visits to sensitive areas such as SPring-8, the world largest synchrotron radiation facility, and the restoration

site of an ancient Buddha statue to which access is normally prohibited. The IChO newsletter *Catalyzer*, including these all items, was published every day for a total of 11 editions.

The good news was that we accepted 312 talented students registered from the highest-ever 85 countries and regions of the 89 to which we sent invitations. I would like to express my sincere gratitude and respect for the wonderful efforts of mentors, teachers, and all concerned in each country (in total, 520) to select talented students and set up the examination sites in their own countries.

The theoretical examinations were held on July 28th in each country: the first started at 12:00 JST in New Zealand, the easternmost country, and the last started at 24:00 JST in the USA and Costa Rica, the westernmost countries. The 5-hour examinations ended at 5:00 am JST on July 29. All examination sites were monitored and recorded throughout the examination via Zoom through 100 PC monitors. It is my great pleasure to report that all theoretical examinations were carried out in an atmosphere of justice, fairness, and trust, maintaining the spirit of IChO, and I thank all the invigilators (in total, 183) for their earnest efforts.

In the Closing Ceremony on August 2, a list of medalists was announced: 33 Gold (top 10%), 67 Silver (next 20%), 94 Bronze (next 30%) and 24 honorable mention awardees (top 10% of non-medalists). I would like to congratulate all the awardees on their very best efforts, showcasing the talents and skills they demonstrate every day.

Now I would like to ask all the participating students to keep the following three things in mind as they reflect on this once-in-a-lifetime valuable experience.

First, they were given hope and courage to overcome difficulties through participation in IChO 2021 Japan.

Second, the unprecedented difficulties we are still facing can only be overcome by international friendships and trust.

Third, I want them to remember that chemistry, the central science, is all around us. Chemistry must therefore play a key role in finding solutions for many global challenges, including the energy, environmental, and resource-related challenges that humanity is now facing.

I hope that IChO 2021 Japan helps to foster many talented young people who will go on to play roles as future world leaders. While these talented students did not have the opportunity to meet each other in person this time, I am convinced that one day they may meet each other somewhere in the world when they go to university or graduate school. I sincerely hope that they take the opportunities given to them as participants in IChO 2021 to create strong networks of international friendship, with the slogan “Chemistry! It’s Cool!” as their watchword.

Finally, I would like to thank IUPAC, the Ministry of Education, Sports, Science and Technology (MEXT Japan) and the Japan Science and Technology Agency (JST) for their

meaningful support, and the more than 180 chemical companies and trading companies in Japan as our sponsors for their substantial financial assistance, as well as numerous personal donations.

My special thanks are also due to all the members of the Japan Committee and Organizing Committee for IChO 2021 Japan, as well as our secretariat and KNT Corporate Business Co., Ltd. Without their remarkable support and endeavors, this remote IChO 2021 Japan would not be possible.



Overview

The IChO program is intended to stimulate students' interest in chemistry through solving creative chemical problems that are both practical and theoretical. In a usual IChO, the participating students are tested on their chemistry knowledge and skills in a five-hour laboratory practical examination and a five-hour written theoretical examination. It also aims to promote international contacts in chemistry, friendships between young chemists of different nationalities, cooperation among pupils, and exchange of scientific experiences in chemistry.

At 47th IChO 2015 in Baku, Azerbaijan, Japan was invited to hold the 53rd IChO in 2021. It was originally planned to follow the 2020 Olympic and Paralympic Games in Tokyo. We anticipated that popular interest in chemistry would be enhanced by a scientific Olympiad being held after the excitement of a sporting Olympiad.

When we heard the first reports of COVID-19 early in 2020, it appeared to be a minor concern. Despite the virus being thought of as causing a new kind of cold, we knew that the common cold is inactive in summer when the IChO was to be held. However, shortly after the pandemic spread across the globe, it became evident that COVID-19 was active in summer, too. The 2020 Olympics and Paralympics were postponed for one year, and the 52nd IChO 2020 in Turkey was held remotely, because the university venue could not be used for an in-person event during the period scheduled for the IChO.

The IChO is composed of three key elements:

(1) Examination

Chemistry is an experiment-based science, with every theory coming out of the laboratory. Therefore, both theoretical and practical examinations play important roles in the IChO.

(2) Communication

Talented students from all over the world come together to take part in the IChO. Conversation, cooperation, and communication with each other provide a great opportunity for promising youngsters to enjoy international experiences and to make friends with other participants via their common interest, chemistry.

(3) Culture

The venue chosen for the 53rd IChO 2021 Japan, the Kansai area, is 500 km from Tokyo and was the ancient capital where the first government of Japan was established 2681 years ago (according to Japanese legend). Several places were to be visited, including not only very old temples but also state-of-the-art scientific institutes.

In the middle of January 2021, the Organizing Committee (OC) of the 53rd IChO 2021 Japan met with the Steering Committee (SC) of the IChO via Zoom. We discussed two proposals: for an in-person IChO and a remote IChO. Unfortunately, it was already clear that all the elements of the IChO described above could not be included in an in-person IChO during the COVID-19 pandemic, due to difficulties in immigration control and the need for social distancing.

The first priority of any IChO is, of course, the safety of all participants. After the meeting with the SC, the OC finally decided to hold the 53rd IChO 2021 Japan as a remote event. At the end of February, when we had our second meeting with the SC, the holding of a remote IChO was approved.

In this remote IChO, the competition only involved theoretical problems, and the students attended the examination from their own countries. Most of the elements essential to the IChO would be lost in the remote IChO, which was very disappointing.

Even in a remote format, however, the important features of IChO must be maintained as much as possible. The participating students must have extraordinary experiences. Therefore, the OC incorporated several activities and communication tools into the 53rd IChO 2021 Japan to cover these important features:

(1) Examination

In order to reinforce the importance of laboratory work, the practical tasks prepared for the 53rd IChO 2021 Japan were made open, despite not being officially approved by the International Jury meeting for the 53rd IChO 2021 Japan. The OC prepared videos in which all tasks were demonstrated with explanations and published the videos as one of the activities during the 53rd IChO 2021 Japan.

The OC will be delighted if those who are inspired by the demonstrations prepare and submit their original videos in which they attempt the practical tasks and discussions. Reports on the tasks will also be highly welcome.

(2) Communication

OC prepared a virtual reality (VR) space for communication. When participants accessed the VR space, their avatars were created. Everyone could participate in events and activities via their avatars. In the VR space, there were venues in which avatars could enjoy close conversations, cooperation, and communication with others.

(3) Culture

IChO participants were offered virtual visits to several locations. Some of these had been planned for the in-person IChO: Nara City, Osaka City, Kyoto City, and Himeji Castle. However, the OC added some that are very interesting to experience but not suitable for in-person visits due to hazards, sensitivity, space limitations, or language difficulties. Spring-8,

a large synchrotron radiation facility that delivers the most powerful synchrotron radiation currently available, is one of the most interesting places in the Kansai area for the participating students of the IChO in particular. However, it is very difficult to visit SPring-8 as an activity in the IChO due to space limitations inside SPring-8 and the sensitivity of its advanced instruments. A workshop for preserving cultural assets, for example, repairing an image of Buddha, is another interesting place where modern chemistry is applied to very old subjects, although it is again very difficult to physically visit such a workshop because of the sensitive work, space limitations, and language difficulties. In the 53rd remote IChO, the participants virtually visited these highly restricted locations to experience more interesting cultural tours than would otherwise be possible.

The preparation of the problems started at April 24, 2018 in the first meeting of Science Committee of OC. After several intensive discussions and meetings, nine theoretical problems and three practical tasks were selected, and were brushed up to high quality problems. To complement these problems, thirty-one theoretical problems and seven practical tasks were prepared to be issued as the Preparatory Problems at February 1, 2021.

The opening ceremony started at 15:00 JST on July 25, 2021. The participants of the 53rd IChO 2021 Japan could access the ceremony via either the VR space or the usual video streaming. Over 200 participants entered the VR space to enjoy the realistic ceremony.

The first version of the theoretical problems was published at 21:00 JST on July 25. It should be noted that 21:00 JST is the almost the only time window to permit cooperation on that day all over the world: 21:00 JST is 24:00 for the easternmost country, New Zealand, and 9:00 for the westernmost country, Costa Rica. Therefore, most of the programs were scheduled at 21:00 JST during the 53rd IChO 2021 Japan.

The Science Committee of OC sought comments on the problems from mentors, revised the problems according to the comments, then proposed a second version of the problems for finalization to the international Jury meeting, the body that decides matters regarding the IChO that bind both participants and organizers. The Jury meeting started at 21:00 JST on July 26 and finished around 2:00 JST on July 27. The Science Committee of OC revised the problems according to the decisions of the Jury meeting and published the official final version at 9:00 JST on July 27. Next, the mentors started to translate the official English version into the individual local languages for their students. All delegations finished their translations by 9:00 JST on July 28.

It should be noted that 60 hours elapsed from the publication of the first version of the problems to the deadline for translation. Of course, contact between mentors and students after the publication of the problems was clearly prohibited in the competition guidelines. If a mentor wanted to cheat, for example, passing on the problems and solutions to his or her

students, we could not prevent it. However, the OC trusted in the professionalism and the pride of mentors. If a mentor had said to their students, “Hey, I’ll tell you the problems and solutions, then you’ll all get gold medals,” they would lose the respect of their students. As expected, there were no suspicious results in the scores obtained by participating students, confirming that the IChO community is strong and ethically healthy.

The translated versions of the problems were made available to the invigilators at 9:00 JST on July 28. The invigilators downloaded and printed out the problems for students by the starting time of the examination. The invigilators are a crucial component of the remote examination. The OC asked country delegations to appoint invigilators who are independent of the mentors, have no relationship with students and have no other activity in the 53rd IChO 2021 Japan. Invigilators were to be socially well-established persons such as school principals and should not be a parent or a relative of a student. For the same reason, the examination location should be a public place such as a school, and the OC requested that each country choose a single location per a country.

Unfortunately, restrictions on movement were very severe in some countries during the period for the 53rd IChO 2021 Japan. Further, some students had to quarantine because their close relatives were infected by COVID-19. In such urgent circumstances, the OC allowed these students to take the examination in their homes, invigilated by their parents. The relevant delegations were asked to guarantee the fairness of the examination, and all delegations worked hard to make the students’ homes suitable as examination locations.

A total of 309 students took the examination, while three students were absent. All examination locations were inspected beforehand via Zoom and were monitored and recorded throughout the examination via Zoom.

The earliest examination started at 12:00 JST on July 28 in New Zealand, the easternmost country, and the last examination started at 24:00 JST in USA and Costa Rica, the westernmost country. The examination time was 5 hours. Participating students were not allowed to use any communication devices or computers during the period 19:00 to 24:00 JST to avoid any ill-intentioned communication via the Internet or social media. All these requirements were controlled by the invigilators.

After the examination, the invigilators sorted the answer sheets by page numbers, scanned them to prepare PDF files for each student, and submitted them to the OC. After all answer sheets were received, the Science Committee of OC started marking at 9:00 JST on July 29. In the same time, a pdf file with the answer and the marking scheme was published to all mentors, and mentors also started marking in their own countries. At 23:00 JST on July 29, we published our marking, and started receiving the request of arbitration from mentors till 20:00 JST on July 30.

The arbitration was carried out from 9:00 JST for easternmost countries to 24:00 JST for westernmost countries on July 31. The final results after reflection of all results of arbitration were sent to each country at 6:00 JST on August 1. It was announced to the mentors that any query for the final results should be sent to the Science Committee of OC within 6 hours, although no argument came to OC. Thus, the scores of all students were fixed and finalized at 12:00 JST on August 1, and the medals were allocated according to the regulation of IChO.

The students were awarded in the closing ceremony at 21:00 JST, on August 2, which was held also in the VR space and later published as a streaming video. Even after the closing ceremony, the participants could still enjoy virtual tours in the VR space.

The 53rd IChO 2021 Japan was financially supported by IUPAC, the American Chemical Society and Chinese Chemical Society in Taipei. These supports were used to subsidize participation fees for some countries that were facing economic difficulties. This year, there were several countries experiencing economic difficulties due to the COVID-19 pandemic.

The 53rd IChO 2021 Japan was totally managed by Zoom and Oly-Exam softwares. Zoom was used for the international discussion, e.g., Jury meeting and arbitration, and monitoring the examination. Oly-Exam was used for the preparation and translation of the examination problems and grading. On-time communication with mentors was carried out with mail and Telegram software.

After several events over the period of 11 days, the 53rd IChO 2021 Japan was successfully completed. We wish to congratulate all participating students. Some received medals, and some did not. However, they all tried their best to tackle the same chemical problems. When these youngsters meet again as the leaders in the field of chemistry, they will talk about the days of the 53rd IChO 2021 Japan. We will be deeply honored if the 53rd IChO 2021 Japan becomes one of the career milestones marked by the excellent chemists of the future.



Nobuhiro Kihara

Member of the Steering Committee
Member of the 53rd IChO 2021 Japan Organizing Committee
Vice Chair of Science Committee
Vice Chair of Executive Committee
Kanagawa University, Professor

The 53rd IChO 2021 Japan

Event Period July 25 ~ August 2, 2021

Main host

The 53rd International Chemistry Olympiad (IChO) 2021 Japan Organizing Committee

Co-host

Japan Science and Technology Agency (JST)

Endorsing Institution

Ministry of Education, Culture, Sports, Science and Technology (MEXT)

Ministry of Economy, Trade and Industry (METI)

Osaka Prefecture Board of Education

Participating countries/regions 79
+ 5 Observer countries

Number of participants 709

Students 312

(Number of examinees 309)

Mentors 160

Observers 51

Guest 1

Invigilators 185

Schedule

Date	JST Time (UTC+9)	Student	Mentor/Observers	Invigilator	SC	Organizer
Jul 22, Thu	21:00				Mock exam	
Jul 23, Fri	21:00		Training of Oly-Exam (Zoom)			
Jul 24, Sat	0:00 21:00			Training of Oly-Exam (Zoom)	Mock discussion	Mock discussion
Jul 25, Sun	15:00 21:00	Opening Ceremony	Opening Ceremony Receipt of the problem for review (Oly-Exam)	Opening Ceremony	Opening Ceremony	Opening Ceremony Publication of the problem (Oly-Exam)
Jul 26, Mon	9:00 21:00		Deadline of feedback (Oly-Exam) Jury meeting (Zoom)		Jury meeting (Zoom)	Jury meeting (Zoom)
Jul 27, Tue	9:00		Receipt of the authorized problem for translation and submission (Oly-Exam)			Publication of the final version of official problem (Oly-Exam) Information of erratum (Zoom)
Jul 28, Wed	9:00 14:00 ↓ 29:00 21:30	Examination (5 h) Asia → Europe → America	Deadline of translation	Receipt of the problem to print out (Oly-Exam) Submission of the solutions (Oly-Exam) within 2 hours after the end of the examination		Observation of every examination (Zoom/video) Receipt of all solutions (Oly-Exam) and reports (mail)
Jul 29, Thu	9:00 9:00 23:00	SPring-8 virtual tour	Receipt of the answer with grading scheme (Oly-Exam) SPring-8 virtual tour Receipt of scores from Organizer (Oly-Exam) Request for arbitration (Oly-Exam)		SC meeting (Zoom)	Distribution of the answer with grading scheme (Oly-Exam) Publication of scores (Oly-Exam)

Date	JST Time (UTC+9)	Student	Mentor/Observers	Invigilator	SC	Organizer
Jul 30, Fri	9:00	Video of Practical Task	Video of Practical Task		Jury meeting (Zoom) SC meeting (Zoom)	Jury meeting (Zoom)
	20:00		Deadline of arbitration request			
	21:00		Jury meeting (Zoom)			
Jul 31, Sat	9:00	Video of preserving cultural assets	Arbitration (Zoom) Asia → Europe → America			Arbitration (Zoom)
Aug 1, Sun	6:00	Virtual visit for Himeji Catle, Osaka, Kyoto	Receipt of final results (mail)			Report of final points (mail)
	9:00		Virtual visit for Himeji Catle, Osaka, Kyoto			
	12:00		Deadline of argument			
Aug 2, Mon	21:00	Closing Ceremony	Closing Ceremony	Closing Ceremony	Closing Ceremony	Closing Ceremony

Profit and loss statement 2019.4~2022.3

income

1 USD → 114 Yen

Account	Dollar
Donation income	1,941,560
Subsidies from the country	1,604,986
Participation fee income	85,865
Interest income	168
Miscellaneous income	414
Total amount	3,632,993

detail

Donation income		Dollar
	Donations from ACS,IUPAC,CSLT	6,217
	Donations from companies	1,915,877
	Donations from individuals	19,465
Total amount		1,941,560

ACS(American Chemical Society)
IUPAC(International Union of Pure and Applied Chemistry)
CSLT(Cheical Society Located in Taipei)

cost

Account	Dollar
labor cost	494,258
Payroll taxes expense	3,786
Welfare expenses	344
Outsourcing cost	2,075,278
Conference expenses	9,548
Traveling expense	88,955
Postage expense	12,163
Supplies expenses	172,710
Office maintenance and management fees	88,272
Member dues	114
Commission paid	2,370
Lease expenses	31,449
Taxes and dues	932
Compensation paid	4,075
Donations expense	3,881
administrative expenses	193,431
Participation fee	17,222
Printing costs	792
Miscellaneous expenses	114
Relocation fee	309
Total amount	3,200,003

detail

Expenses directly related to the 53rd IChO 2021 Japan 2021.7.25~8.2		Dollar
	VR-AVATER production cost	666,349
	Video production cost	511,650
	labor cost	90,788
	Ceremony production cost	53,070
	accommodation charge	68,068
	Meeting room rental fee	527,904
	cost of a meal	9,491
	Courier fee and others	4,439
	PC rental fee for monitoring, etc.	31,546
	Medals and other souvenirs	95,750
	shipping charges	81,013
	part-time job offer	12,934
Total amount		2,153,002