

4th IYNT 2016: *Information booklet*

Greetings from Dr. h.c. Evgeny Yunosov

IYNT, Founder & Chairman of the General Council
IYPT, Founder & Honorary Vice-President
Foundation for Youth Tournaments, President
Dr. h.c.: Ural Federal University, Russia, 2016

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Dear friends,

The IYNT is a globally unique scientific event that brings together professional competence and the excitement of youth.

The IYNT, now in its fourth year of existence, is gradually gaining momentum to become a leading hub in the promotion of science and one of the World's most fascinating science competitions. General Council of the IYNT, its supreme governing body, positions the IYNT as a true ambassador of science.

I greet all the young participants of the IYNT. The Science Fights of the competition will allow you to discuss, argue, defend your solutions, and discover that science is much more fun and entertaining than many students of your age can imagine.

The IYNT is a competition for teams rather than individual entrants. It underpins cooperation and promotes team work. Such a team work attracts students with different skills, abilities and interests.

I greet all the Team Leaders. Your keen interest in science, your enthusiasm, and your dedication to inspire students has already made you exceptional educators. I hope that the IYNT helps you to grow professionally and find many colleagues and allies in different corners of the World.

I greet all Jurors and experts of the IYNT. Problems of the IYNT required dedication and prolonged work from students and their teachers. When evaluating the solutions, you will need to be an objective judge and a responsible senior colleague of the IYNT entrants.

The problems of the IYNT concern the natural sciences as a whole. When working on the problems, you could notice that the World can be studied

without mapping artificial boundaries between such disciplines as physics, chemistry, and biology.

The main problems for the 4th IYNT 2016 were released in Belgrade during the last hours of the previous IYNT. The Science Fight 3 will in particular focus on the problems *Invent Yourself* with their topics narrowed down by participants themselves. The quality of the original statements for *Invent Yourself* will be graded by the Jury. The Science Fight 4 will feature fascinating experimental problems that will be presented to participants immediately before the Science Fight.

The movement of youth tournaments, such as the IYNT and the IYPT, unites all those who believe that pursuit of education and research are the most important values in life.

The future development of the IYNT can rest on three strong pillars: exceptional quality of our problems, regulations, grading, and procedures; exploiting growth opportunities to attract new teams and new nations; and partnering with outstanding hosts to bring our participants together in some of the World's most remarkable places.

Hosting an event comparable to the IYNT can make an impact on the reputation of a research-based university which Shiraz University is. By staying at the heart of a truly global science event, Shiraz University will deliver a persuasive message to its international partners. It gave me, in my capacity as Founder of the IYNT, pleasure to invite Dr. Majeed Ershad Langroodi to assume during these days the respected title of the Honorary President of the 4th IYNT 2016 in Shiraz. I am glad to hear from Dr. Majeed Ershad Langroodi that he is eager to witness more competitions of this type at Shiraz University.

Iran and our local partner Dr. Dina Izadi of Ariaian Young Innovative Minds Institute have previously organized different major scientific competitions, including the 24th International Young Physicists' Tournament in 2011. I value their efforts in making the 4th IYNT 2016 a memorable and special event in the culturally unique city of Shiraz

I wish that everyone has a true pleasure in participating at the 4th IYNT 2016.

Good luck!

Greetings from Dr. Ilya Martchenko

IYNT, Speaker of the General Council
IYPT, Treasurer & Member of the Executive Committee
Foundation for Young Tournaments, Science & Outreach
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Dear colleagues,

I am happy to welcome participants, jurors, experts and local organizers of the 4th International Young Naturalists' Tournament in Shiraz.

The IYNT appeals to an audience younger than most other science competitions yet sets very high benchmarks. The IYNT is renowned by its thrilling interdisciplinary problems and a growing community of friends.

The IYNT continues its journey across the planet from Turkey in 2013, to Bulgaria in 2014, to Serbia in 2015, now to Iran in 2016, and next to China in 2017.

Iran was among inaugural participants of the 1st IYNT 2013. It now returns to the IYNT as a host nation with an unprecedented number of national teams.

In his 2012 decision to establish the IYNT, Evgeny Yunosov set a semi-explicit goal in attracting new nations to the International Young Physicists' Tournament, as the IYNT participants come of age and would be willing to enter the IYPT in their last one or two years in high school. Although these two countries are not present at the 4th IYNT 2016, I hope that Serbia and Turkey will be the first among such participant nations at the 30th IYPT 2017 in Singapore.

When preparing to the IYNT and when entering the competition now, our participants learn how real scientists tackle different experimental, theoretical and organizational problems. Setting priorities and doing prolonged experimental investigations are among the skills that are important in any career.

I hope you will enjoy your time in Shiraz and that the 4th IYNT 2016 becomes a very special and positive experience for each of you.

I would like to thank our partners at AYIMI in Tehran and Shiraz University. I thank the efforts of Dr. Dina Izadi, Chairwoman of the LOC, as well as all of her volunteers and colleagues.

I thank our Situation Center and its Chairperson Mr. Andrei Klishin, as well as all members of the General Council, for many months of hard work in preparing this indisputably memorable event.

I welcome and greet our Scoring Commission and its Chairperson, Mr. Hieorhi Liašnieūski, who took over scoring and processing of the results. Thanks to him we will have accurate and timely results of the 4th IYNT 2016.

The IYNT is impossible without devoted work of many expert Jurors. During each IYNT, we brief Jurors and Teams on our grading and scoring criteria. Our guidelines have evolved since 2013, and as of now consist of four partial grading criteria. Our aim is to keep the guidelines clear and simple, and make sure that each Juror relies on the same criteria when evaluating performances in all parallel Groups. During the 1st, 2nd and 3rd IYNTs taken together, 2814 Grades were delivered in 150 stages. Each of the 450 performances therefore obtained its Grades G from an average of $n=6.25$ Jurors. The IYNT procedures and in particular the Criterion of Victory V alleviate Group-to-Group and Juror-to-Juror scaling differences, and allow separation of each Team in the IYNT with a two-sigma significance threshold.

I would like to welcome all Jurors and participants to find more information about our procedures and the statistical significance of the IYNT results at iynt.org/grading.

Science is fascinating. It is our privilege to see many talented, ambitious and curious minds discussing science at the IYNT.

Today, I very truly hope that the 4th IYNT 2016 helps you shape your future interests in life and in science. I look forward to meeting you at the Science Fights.

Enjoy the IYNT and let me wish you every success.

Greetings from Dr. Majeed Ershad Langroodi

4th IYNT 2016, Honorary President
Shiraz University, Chancellor
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As the chancellor of Shiraz University I would like to take this opportunity to express a warm welcome to all participants of the 4th International Young Naturalists' Tournament (IYNT) held in Shiraz in 2016.

Established in 1946 under the name of Pahlavi University in Shiraz, Shiraz University has managed to portray itself as an Iranian frontend of innovation time and again in the homeland to Persian civilization as well as literature famed by poets Hafez and Sa'di. Consistently ranked Iran's second best comprehensive university, Shiraz University has always been a pioneer in establishing new majors in doctoral programs, in extending towards E-learning, international divisions and in shaping the future of Iran's development by making connections with different industries.

This university has constantly strived to support and elevate the level of innovation by supporting and paving the way for new innovative ideas through different national and international conferences and scientific tournaments. These gatherings bring us a chance to maintain a stronger connection among the different sectors involved in the expansion of science, not only in Shiraz and Iran, but also among other countries. For example, the 7th National Festival of Harkat opening was held just recently here at Shiraz University which aimed at gathering around different scientific associations from all around Iranian universities.

I would like to take this chance to thank everyone who was one way or another involved in the planning and performing of this tournament, from the organizing and scientific committees to all sponsors and also Iranian and non-Iranian participants.

Wishing everyone a pleasant stay here at Shiraz and a good competition among all participants, I would like to express our eagerness in witnessing more competitions of this type here at Shiraz University.

Greetings from Dr. Dina Izadi

IYNT, Chair of LOC 2016 & Member of the General Council
AYIMI, Researcher & Director
IYPT, ICYS, IJSO, IPT, INST, IOC member for Iran
Dr. en Ciencias en Fisica Educativa: IPN, Mexico, 2014

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Dear Participants,

On behalf of the Ariaian Young Innovative Minds Institute, AYIMI, I would like to express our welcome to all the participants in 4th IYNT in Shiraz, Iran. We are delighted to have you here as junior scientists who are going to show your novelties in solving problems by research and experiments. This great event has been organized by AYIMI and Shiraz university one of the most prominent research-oriented universities in Iran and the region.

Science and Technology have enormous impact on development and imagination is a key to bringing dreams into reality. To show your dreams out of your minds, but mixing with scientific ideas which help you to build or even invent something that can be used in research projects we ask you to take part in our parallel program as Science+Art=Happiness with several prizes too.. All details can be found on IYNT 2016 official website.

IYNT 2016 will be a valuable opportunity according to our mission to provide an attractive environment among junior students to compete with each other in a friendly manner. We are honored to have professors and teachers as leaders and visitors from several countries.

Shiraz as the venue of IYNT 2016 ,is a city of sophistication that has been celebrated as the heartland of Persian culture for more than 2000 years and is known as the City of Roses and Nightingales . We are going to offer you Iranian traditional culture and architecture by excursions during IYNT 2016. The Shrine of Shahe-e-Cheragh, Persepolis, Vakil Bazar, Hafez and Saadi tomb are some of the places in Shiraz for sightseeing which we hope you all enjoy.

We happily invite all teams to the hospitable Persia, a beautiful country with a rich cultural heritage on July 16-22, 2016.

Greetings from Mr. Andrei Klishin

IYNT, Chairman of the Situation Center
IYPT, IOC member for United States
University of Michigan, grad student
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Dear participants, jurors and guests!

It is my pleasure to welcome you to the 4th International Young Naturalists' Tournament. Once again, the young minds from across the globe would challenge each other and compete in the elegance of theories and the cunning realizations of their experimental setups. For a week, the participants will try to defend their own research and poke holes in the projects of other teams. For a week, the competent jury of scientists and teachers from many countries will evaluate the successes and shortcomings of the entrants and ultimately determine the winners.

As you well know already, there is no way to solve the IYNT problems by sheer logic, brainpower or speculation. Instead of that, each problem asks you to look at empirical evidence from different fields of study. As we put together the sets of problems, we are constantly trying to expose our participants to new areas of science.

The empirical reasoning and the scientific method are found everywhere and can be used anywhere, as the problems for the 4th IYNT illustrate.

The IYNT organizers are themselves practicing scientists. Scientific method and analysis of available evidence are something that we use every single day. We have spent the past year now only working out the everyday problems of our jobs in schools and universities, but also looking back at the IYNT history as data and thinking how to make the IYNT even better.

Back in 2012, the IYNT initiators made a lot of guesses about how to properly set up the competition and grade it. Many of our friends have extensive experience of the IYPT and other scientific competitions and provided their extremely useful advice. We put together the first version of rules and used it since with minor annual changes and updates.

In the past three tournaments, many of our entrants had lengthy discussions about the IYNT grading system. Now we can make a more informed argument for why the IYNT is graded the way it is. We are not changing the rules – but we are finally providing a solid basis for them to be in place. And we do it in the most straightforward way – by looking at the empirical evidence.

Let's assume that a number of teams arrive at yet another IYNT each possessing some objective skill level. We want to rank the teams by their yet-unknown skill and level of performance, so we poke at the teams with our existing “measurement apparatus” – our best-guess tournament regulations and a finite number of diverse jurors who try and more or less succeed in following them (note the emphasis on all the imperfections). The question is simple: “It is possible to accurately distinguish the performance level of the teams with our noisy and imperfect apparatus?” The short answer that we found is “Yes”. For the long answer, I would like to direct you to <http://iynt.org/grading>, the product of a lengthy investigation by the statistical genius of Ilya Martchenko.

Honest scientific competition is what the IYNT is about. Though, I want to also mention briefly what the IYNT is not about. The IYNT is a strongly apolitical organization and event. Our countries and governments may have disagreements, but we don't let those stand in our way.

I feel especially proud that you are reading these lines on the soil of Iran. Our LOC Chairwoman Dina Izadi successfully organized the 24th IYPT 2011 in Tehran and has done lots and lots of work to promote the case of STEM education. We hope that participation in the IYNT expands not only your scientific horizons, but also enriches your cultural experience.

As you walk the streets of Shiraz, as you take breaks between Science Fights, as you share in the majestic Iranian cuisine – take a moment to talk to your fellow colleagues, young students from other countries. They come from different places, but they tried their best to solve the scientific problems with a clear and unbiased head, just as much as you did. You have a lot to learn from each other.

I wish you a successful IYNT and many enriching and safe travels afterwards!

General Council of the IYNT

Dr. h.c. Evgeny Yunosov

Chairman of the General Council

IYPT, Founder & Honorary Vice-President

IYNT, Founder & IOC Chairman

Foundation for Youth Tournaments, President

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Dr. Ilya Martchenko

Speaker of the General Council

IYPT, Treasurer & Executive Committee member

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Dr. Dina Izadi

Member of the General Council

Ariaian Young Innovative Minds Institute, president

IUPAP Working Group 5, member

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Dr. Andrey Kravtsov

Member of the General Council

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Mr. Leonid Markovich

Member of the General Council

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Local Organizing Committee 2016

IYNT 2016 Local Organizing Committee (LOC) is a cooperation committee between AYIMI and Shiraz University.

Dr. Majid Ershad Langaroodi (President)

Dr. Ahmad Oryan (Vice Chancellor for Research Affairs)

Dr. Seyyed Mohsen Taghavi (Vice Chancellor for Academic Affairs)

Dr. Masoud Hosseinchari (Vice Chancellor for Cultural & Social Affairs)

Dr. Majid Movahed (Vice Chancellor for Student Affairs)

Dr. Mahmoud Moradi (Faculty of Sciences President)

Dr. Habib Sharif (Fars Elites Foundation president)

Dr. Keramatolah Sharafi (Sampad)

Dr. Ahmad Sheikhi (Scientific Committee)

Dr. Sedigheh Forootan (Executive Committee)

Dr. Dina Izadi (Representative of IYNT in Iran and GC member)

Dr. Zohre Azimifar (Public Relations)

Secretariat in Shiraz: Zeinab Nezhad Mazare

The local webpage is maintained at *iynt.ayimi.org*.

IYNT 2016 Execution Task Force

Andrei Klishin

Chairman of the IYNT Situation Center

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Ilya Martchenko

Speaker of the IYNT General Council

Responsibilities: operational decisions, budgeting, briefings, continuity, stability, compliance, selection and preparation of main and additional problems, regulations, protocols, problems for Captain's Contests, booklet preparation, IYNT execution

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Evgeny Yunosov

IYNT Founder and Chairman of the GC

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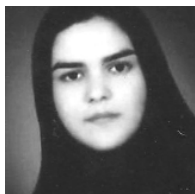
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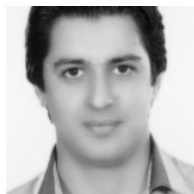
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Problems for the 4th IYNT 2016

“The first thing I want to say is thank you for letting me speak and thank you for not canceling my fellowship because I was younger than you might have expected. Often, I am younger than I might have expected, but this does not stop me from doing my work.”

Reif Larsen, “The Selected Works of T.S. Spivet”

1. Invent Yourself: Air Traffic

Some web services, e.g. Flightradar24, aggregate and provide data on positions, altitudes, speeds, and other parameters of almost any commercial flight in the World. Suggest an investigation of an interesting scientific aspect of air traffic or flights using such data.

2. Invent Yourself: Weather Forecast

It is often argued that some of weather lore is true and has predictive value. Suggest a scientific test of two popular sayings forecasting respectively short-term and long-term weather trends.

3. Invent Yourself: Human Reaction Time

The time of human reaction to sound, light, and other stimuli is an interesting parameter. What does this time depend on? Propose an interesting experimental study that concerns the time of reaction.

4. Van der Graaf’s Cat

A cat may crackle when petted. Parameterize and investigate the static electricity in cat’s fur. How can one make this static discharge stronger or weaker?

5. Tempest in a Glass of Water

When water is poured into a glass, its dynamics is complex and intense. Even when the liquid surface settled down, it may take time before the water flow slows down and stops. Investigate this storm in a glass.

6. Dice

In many games, dice are thrown to obtain random results. How does the result of a die roll depend on its height above a table, if the die is released at zero initial speed?

7. Plants in Motion

Various plants can turn in response to the position of the sun or other light sources. Investigate this motion experimentally and theoretically.

8. Zipf's Law

Human language is described by unusual distributions. Take your favorite book and count how many times the most frequently appearing word (rank one) appears; the second most frequent word (rank two) appears, etc. Investigate and explain the dependence of the word count on its rank in the frequency table. Would it be the same for another book in the same or different language?

9. Cinder

In the Middle Ages, people used to wash the cloth in cinder. Study the effectiveness of cinder in washing clothes.

10. pH Indicator

The juice of many fruits or vegetable crops contains a natural pH indicator that changes colors according to the acidity or basicity of the solution. Investigate such pH indicator juices and their mixes. Propose the most precise and effective composition and compare its properties with those of common indicator paper.

11. Corrosiveness of Cola

It is often argued that cola is so corrosive that can be used to clean metal objects. Investigate this property of cola.

12. Ants and Food

Investigate what food attracts ants. Try different foods and introduce parameters to describe the reaction of ants.

13. Firelighting

Investigate various methods to start a fire by friction.

14. Effervescent Tablet

The rate of some chemical reactions may depend on surface area. Break effervescent tablets into smaller parts, or stir them into powder, to study how the dissolution rate depends on the surface area.

15. Mountain Peaks

What methods are used to determine the elevation of the World's highest mountains? Suggest your own experimental method and determine the height of a mountain or a hill of your choice.

16. Two Shovels

Sink two metal shovels deep into the soil outdoors, e.g. in a garden or in a field. Determine the dependence of the resistance between the two shovels on the distance between them in a sufficiently wide range, e.g. 0 to 25 meters.

17. Swadesh List

Many words in related languages (e.g. Kazakh and Turkish, or Croatian and Belarusian) can match or differ by a few sounds only. Study this similarity quantitatively for the language pairs of your choice. When did these languages separate from a common ancestor?

The problems are authored by Tatyana Korneeva, Alexander Korotkov, Andrei Malykhin, Ilya Martchenko, and Evgeny Yunosov. Selected, prepared, and edited by Ilya Martchenko and Evgeny Yunosov. This official set of problems for the 4th IYNT 2016 is approved by General Council of the IYNT and can be used only at the events endorsed by the General Council of the IYNT.

Released in Belgrade on June 24, 2015.

Regulations of the International Young Naturalists' Tournament

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Chapter 1. General information

I. International Young Naturalists' Tournament

The International Young Naturalists' Tournament (hereinafter the *IYNT*) is a team competition for school students in their ability to solve research problems of natural sciences, convincingly present their solutions, and defend them in scientific discussions called Science Fights (hereinafter *SF*.)

II. General Council

The IYNT is solely governed by the General Council (hereinafter the *GC*) established by the Founding Members of the IYNT. The GC presides over the manner in which the IYNT is held, releases its problems, approves the Regulations and ensures their implementation, and has ultimate authority over the IYNT competition. The GC establishes other principal Bodies, Centers and Committees of the IYNT, assigns their responsibilities, and appoints

Chairpersons. The GC entrusts Local Organizing Committees with hosting each respective IYNT event.

III. Local Organizing Committee

The Local Organizing Committee (hereinafter the *LOC*) provides board, lodging and premises, and ensures all necessary conditions and facilities to conduct the IYNT competition in the host country. The LOC determines the venue of the IYNT and its schedule in agreement with the GC.

IV. Participants

1. The participants are aged 12 through 16. The age limit is set such that participants of the IYNT must not turn the age of 17 years during the calendar year of the respective IYNT competition.
2. Each Team is composed of six Team Members, including one Team Captain. The GC may allow participation of smaller Teams. The Captain is the official representative of the Team during the IYNT. No Team Member and no Captain can be replaced after the Opening Ceremony.
3. Each Team is accompanied by two adult Team Leaders who supervise their Team and work in the Jury.
4. To participate, a Team must pre-register for the IYNT and subsequently fulfill the requirements for registration. These requirements are determined and made public by the GC.

V. Agenda

The agenda of the IYNT includes the following rounds graded by the Jury and social activities:

- Opening Ceremony;
- Introduction of Teams via short performances (graded round);
- Drawing lots;
- Taking a group photograph of all participants by the LOC;
- Jury briefings;
- Two Selective SFs with main IYNT problems (graded rounds);
- One Selective SF with the problems *Invent Yourself* (graded round);
- One Selective SF with additional IYNT problems (graded round);
- One Semi-Final SF (graded round);
- One Final SF (graded round);
- Cultural program provided by the LOC;
- Unofficial contests in various nominations (not used in the official ranking of Teams);
- Closing and Awards Ceremony.

VI. Introduction of Teams at the Opening Ceremony

Each Team introduces themselves in a short artistic performance during the Opening Ceremony. The performance can be of any genre. Team Leaders may participate. The Teams can in particular produce and display a short video about them. The duration of the Introduction is limited to 3 minutes. Exceeding this time limit incurs a penalty. By the end of the IYNT, the Teams submit any audiovisual materials of their Introduction (e.g. videos or slides) to the GC for archiving, and must ensure that the files are safely kept.

VII. Problems

1. **Main problems** are research oriented experimental and theoretical problems in natural sciences released by the GC to the Teams and the general public in advance but not earlier than on the closing day of the previous IYNT. These problems may be used in national or regional competitions recognized by the GC.

2. **Problems *Invent Yourself*** are open-ended questions that ask the Teams to specify and formulate their own problem statements and solve the respectively stated tasks. The general descriptions of these problems are released by the GC together with the main problems. Teams must release their original written statements of the problems *Invent Yourself* to the GC no later than in the beginning of the IYNT. The submitted statements of the problems are made public.

3. **Additional problems** of the IYNT are not published in advance and are released to the Teams by the GC directly in the course of the IYNT. These problems are research oriented and are solved by the Teams during the respective SF.

VIII. Science Fights

A Science Fight (*SF*) is a meeting of three or two Teams in which the Teams discuss and present their solutions of the IYNT problems. There are five types of SFs in the IYNT which differ in the type of problems, in the agenda, and in the eligibility of Teams to participate.

1. **Selective SFs with main problems** are conducted according to the Standard SF regulations and use the main IYNT problems known to the Teams in advance. All Teams participate.

2. **Selective SF with the problems *Invent Yourself*** is conducted according to the Standard SF regulations. Each Team presents and defends their own problems

Invent Yourself. Only those Teams participate that have timely released their original statements of *Invent Yourself*.

3. **Selective SF with additional problems** is conducted according to the Standard SF regulations with changes in the preparation time and challenge procedure. This SF uses the additional problems released to the Teams by the GC immediately before the SF. All Teams participate.

4. **Semi-Final SF** is conducted according to the Standard SF regulations with an omitted challenge procedure. Main IYNT problems and problems *Invent Yourself* are used. Only appropriately determined winners of Selective SFs participate.

5. **Final SF** is conducted according to the Standard SF regulations with an omitted challenge procedure. Main IYNT problems and problems *Invent Yourself* are used. Only appropriately determined winners of the Semi-Final SF participate.

IX. Jury

1. In all SFs, the Jury evaluates the solutions of the IYNT problems presented by the Teams and the Team performances by publicly showing integer Grades. The grading reflects whether a Team is successful in their performance. Guidelines and particular criteria aimed at improved grading are made public by the GC. Each individual Juror decides on each Grade and bears sole responsibility over the Grade. Each Grade is public. No Grade can be corrected retroactively. Each Juror must publicly justify any of their Grades upon the request of Team Captains or the Chairperson.

2. The Jury for each SF Group is composed of independent experts and Team Leaders such that their Teams do not take part in the respective Group. The Jury for each Group is formed by the GC in cooperation with the LOC.

3. One of the Jurors in each Group is the Chairperson who conducts the SF and ensures that the Regulations are respected. The Chairperson is appointed by the GC or by an accredited Committee before the beginning of the SF.

X. Official language

The official language of the IYNT is English.

Chapter 2. Science Fights

I. Standard Science Fight regulations

1. Each SF in each Group is conducted by the Chairperson who facilitates discussions, announces the ordering, manages time, clarifies the Regulations, and ensures their implementation. In the beginning of a SF, the Chairperson asks Jurors to introduce themselves, and asks Team Captains to introduce their Team Members. At the SFs from the Selective SF 4 onwards, the Chairperson carries out the Captain's Contest in the beginning of the SF.

2. In the Groups of three Teams, the SF is carried out in three Stages. In each Stage, each Team plays one of the three roles: the Reporter, the Opponent, and the Reviewer. The roles are assigned in the following order:

3 Teams	Stage I	Stage II	Stage III
Team 1	Reporter	Reviewer	Opponent
Team 2	Opponent	Reporter	Reviewer
Team 3	Reviewer	Opponent	Reporter

3. In the Groups of two Teams, the SF is carried out in two Stages. In the Stage I, one Team acts as the Reporter, and the second Team is divided into two independent sub-teams that take the roles of the Opponent and the Reviewer, respectively. The division takes place before the challenge procedure in the beginning of the Stage. Team Captain decides how the Team is divided and appoints a temporary acting Captain for the sub-team from which he or she is absent. In the Stage II, the Teams change their roles. The roles are assigned in the following order:

2 Teams	Stage I	Stage II
Team 1	Reporter	Opponent, Reviewer
Team 2	Opponent, Reviewer	Reporter

4. In the first three Selective SFs, the sequence of performances is determined by the Tournament Bracket established at the Opening Ceremony. In the Selective SF 4, in the Semi-Finals, and in the Finals, the sequence of performances is determined via Captain's Contest conducted by the Chairperson in the beginning of the SF before Stage I. The Captain's Contest has a sole winner. The winner determines the roles of all Teams in Stage I and thus the sequence of performances in the whole SF. The Captain does not interact with their Team during the Captain's Contest and when deciding on the sequence of performances.

5. Only one Team Member takes to the floor as Reporter, Opponent or Reviewer on behalf of their Teams. All other Team Members may work as assistants, offer technical support to the presenter, pass handwritten notes and, if allowed by the Chairperson, make short remarks.
6. In the course of one Stage, Members of one Team communicate only with each other. They have no right to use mobile data transfer and other technical means to communicate with anyone outside their Team, in particular Team Leaders.
7. Prior to announcing their Grades, Jurors have no right to express their judgment or opinion. Jurors have no right to explicitly examine textbook knowledge of Team Members or pose the same question to several Teams at once.
8. Before the Jurors show their Grades, the Chairperson checks that each Juror has filled and signed their individual protocol and has clearly recorded their Grades. In case of any discrepancy between the protocol and the displayed Grade, the protocol is considered correct.
9. Chairperson and Team Captains can ask any Juror to justify any of their Grades, in particular the extreme Grades.
10. If a Team does not show up for a SF, the Chairperson reports to the GC. The GC establishes the whereabouts of the Team and may resolve to conduct the SF without the absent Team as a two-team SF. If the Group in question is planned as a two-team SF, the GC may introduce a one-time amendment in the distribution of Teams, upon the discretion of the GC.

II. Standard Stage regulations

1. Each SF is composed of three of two Stages. Each Stage is composed of separate Phases according to the agenda in the table below. In a two-team SF, each Stage begins with one of the Teams dividing into two independent sub-teams, of which one acts as Opponent and the other acts as Reviewer. Asterisk (*) denotes the positions where Standard Stage regulations should be amended for particular types of SFs.

#	Phase	Duration
1*	Challenge by the Opponent	1 min
2*	Accepting or rejecting the challenge by the Reporter	1 min
3**	Preparation of the Reporter	3 min
4	Presentation of the report	8 min
5	Clarifying questions of the Opponent to the Reporter	3 min
6	Preparation of the Opponent	3 min
7	Statement by the Opponent	4 min
8	Discussion between the Opponent and the Reporter	5 min
9	Clarifying questions of the Reviewer to the Reporter and the Opponent	2 min
10	Preparation of the Reviewer	2 min
11	Statement by the Reviewer	3 min
12	Concluding remarks of the Opponent	1 min
13	Concluding remarks of the Reporter	1 min
14	Clarifying questions of the Jury to all speakers	5 min
15	Grading	4 min
16	Concluding remarks of the Jury, justification of Grades	4 min
17	Break	10 min
	Total for one Stage (no break incl., appx.)	50 min
	Total for a three-team SF with 2 breaks (appx.)	3 h
	Total for a two-team SF with 1 break (appx.)	2 h

* In the Selective SF with additional problems, consecutive challenges by all Teams are carried out in the beginning of the SF. The order of challenges is determined by Captain's Contest. In the Semi-Finals and Finals, the challenge procedure is omitted.

** In the Selective SF with additional problems, the preparation time is used by all Teams for solving an accepted problem. The preparation time is 45 minutes.

2. The Chairperson must rigorously keep the time limits for each Phase.

III. Team roles in the Stage

1. **The Reporter** presents an original solution prepared by their Team. The Report contains the basic ideas and methods for the solution, the description of observations and experiments, theoretical analysis, and also clear conclusions. The Reporter must explicitly cite the sources of any ideas, data or theories which are not of own work. The standard visual aids for the report are multimedia slides with graphs, figures, data, mathematical expressions, photos, or videos. Other visual aids may include experimental demonstrations or handout sheets. By the end of the IYNT, the Reporter submits a copy of their

solution (i.e. slides or written reports) to the GC for archiving, and must ensure that the files are safely kept.

2. **The Opponent** presents a critique of the Report, including its contents and form, and leads the discussion with the Reporter. The Opponent justifies their agreement or disagreement with the methods, results, and conclusions presented by the Reporter. The Opponent challenges each aspect of the Report and discusses possible improvements. The Opponent points to inaccuracies and errors in the understanding of the problem and in the solution, but also points to achievements and strong sides of the Report. Whilst the Opposition must focus on the Report only and may not be a presentation of their own solution, the Opponent can cite literature and own results to justify particular criticisms. By the end of the IYNT, the Opponent submits a copy of their opposition (e.g. slides or written notes) to the GC for archiving, and must ensure that the files are safely kept.

3. **The Reviewer** summarizes and assesses the outcome of the debate between the Reporter and the Opponent, and draws weighted and independent conclusions. The Reviewer presents a short evaluation of the performances of two other teams, pointing to their strong sides and shortcomings. As the Reviewer does not select the reviewed problem, he or she thus expresses their critical third-party view on the essential points raised in the debate and concludes this debate. Whilst the Review must focus on the performance of two other Teams only and may not be a presentation of another solution, the Reviewer can cite literature and own results to justify particular opinions. By the end of the IYNT, the Reviewer submits a copy of their review (e.g. slides or written notes) to the GC for archiving, and must ensure that the files are safely kept.

IV. Limitations on Team Members to take the floor

1. During any single SF (Selective, Semi-Final or Final) any Team Member may take the floor only once.
2. Throughout all SFs taken together, except for the Finals, any Team Member may take the floor in each role only once, i.e. once as Reporter, plus once as Opponent, plus once as Reviewer.
3. In the Final SF, there are no limitations related to earlier performances of individual Team Members. Any of them can however take the floor only once.
4. Penalties are applied if these limitations are not respected.

V. Rules of challenge and rejection

1. In any SF with a challenge procedure, the Opponent can challenge the Reporter on any problem available for such a SF, except for those problems that:

- a. have been presented in this SF by another team;
- b. the Reporter has previously reported (in any earlier SF);
- c. the Opponent has previously reported;
- d. the Reporter has previously opposed;
- e. the Opponent has previously opposed.

2. The Reporter can reject the challenge. Such a rejection is recorded in the protocol. In such case, the Opponent makes a new challenge.

3. It is allowed for the Opponent to make a new challenge on the problem that has been previously rejected by the Reporter. If the Reporter rejects, this is not counted as a new rejected challenge.

4. In a situation that no problems are left for a challenge, the restrictions are lifted in the following order: first e., then d., then c., then b., then a.

5. Throughout all SFs, the total allowed number of rejected challenges not incurring a penalty is **three**.

6. Penalties are applied to the Reporter for rejecting a challenge if the Reporter has exceeded the allowed number of rejected challenges.

Chapter 3. Grading, Penalties and Results

I. Grading parameters

1. Grade (G)

Each Juror evaluates the Team performance by giving integer Grades G . In any SF, the Grades are in the following range:

To the Reporter in a SF	from 1 to 30;
To the Opponent	from 1 to 20;
To the Reviewer	from 1 to 10.

In the Opening Ceremony, the Introduction of Teams is graded in the range from 1 to 10.

2. Average Point (P)

The Average Point for any performance is calculated in the following manner. Two extreme Grades, one maximum and one minimum, are replaced with one grade equal to their arithmetic mean. In the next step, the Average Point P is

determined as the arithmetic mean of the new data set of $n-1$ grades. Any Average Point is rounded to the nearest 0.1 of a point.

3. Sum of Points (*SP*)

The Sum of Points for the Introduction of Teams at the Opening Ceremony is equal to the Average Point earned, with any penalties applied. The Sum of Points in a SF is equal to the arithmetic sum of all Average Points for the Team in all performances in the said SF, with any penalties applied. Any resulting Sum of Points is rounded to the nearest 0.1 of a point.

4. Total Sum of Points (*TSP*)

The value of *TSP* is equal to the sum of all *SPs* earned by the Team in all completed SFs and in the Introduction of the Team. The resulting value is calculated after each SF.

5. Criterion of Victory (*V*)

For the Team with the highest *SP* in a SF Group equal to SP_{max} , the Criterion of Victory is set to $V=1$. For the Teams in the Group which have $SP \geq (SP_{max}-2)$, the Criterion of Victory is set to $V=1$. For the Teams in the Group which have $(SP_{max}-10) \leq SP < (SP_{max}-2)$, $V=0.5$. For the Teams in the Group which have $SP < (SP_{max}-10)$, the Criterion of Victory is set to $V=0$.

6. Sum of Victories (*SV*)

The parameter *SV* of a Team equals the arithmetic sum of Criteria *V* in all completed SFs.

7. Rank (*R*)

The Rank *R* for a Team has integer values from 1 to *N*, where *N* is total number of Teams in the IYNT. It indicates the placing of a Team in the list of all Teams sorted descending. The value of *R* for each of *N* Teams is calculated after each completed Selective SF and Semi-Final SF. The top Rank ($R=1$) is assigned to the Team that has the highest Sum of Victories (*SV*) at the end of all preceding rounds. In case of equal *SV* for two or several Teams, their Rank is determined via comparison of other grading parameters in the following order:

- a. Total Sum of Points (*TSP*) after all preceding rounds;
- b. the sum of Average Points (*P*) for all Reports in all preceding SFs;
- c. the sum of Average Points (*P*) for all Oppositions in all preceding SFs.

If the listed criteria are not sufficient to unambiguously resolve the ranking of the Teams, the GC introduces additional criteria allowing determination of a univocal ranking. Rank *R* is the only criterion to determine Teams that participate in the Semi-Finals and a supporting criterion to determine Teams that participate in the Finals.

II. Penalties

1. Yellow Cards and Summing of the penalties

Penalties during a SF are applied only to the *SP* earned during the said SF. A Yellow Card is used to indicate each penalty. A Yellow Card issued to a Team reduces the *SP* in this SF by 10%; two Yellow Cards issued to a Team during a SF reduce the *SP* by 20%; three Yellow Cards reduce the *SP* by 30%, etc. The penalties for various violations are applied independently and sum up.

2. Number of rejected challenges (*NR*)

If the total number of rejected challenges in all (the current and all preceding) SFs exceeds the limit by one, a Yellow Card is issued; if it exceeds the limit by two, two Yellow Cards are issued, etc. If there is no rejected challenge in a particular SF, the *SP* in this SF is not penalized even if the total number of rejections in preceding SFs has exceeded the limit. Repeated rejection (if a challenge on the same problem has been rejected by the Reporter previously) is not counted as a new rejection.

3. Number of individual performances in one Science Fight (*NP*)

Any individual Team Member is allowed to take the floor only once during a SF. If a Team Member takes the floor in two roles, one Yellow Card is issued; if a Team Member takes the floor in three roles, two Yellow Cards are issued.

4. Total number of individual performances in Selective and Semi-Final Science Fights (*NT*)

Throughout all SFs taken together, except for the Finals, any individual Team Member is allowed being Reporter only once; plus being Opponent only once; plus being Reviewer only once. Each violation results in one Yellow Card.

5. Duration of one performance (*DP*)

If the duration of Team performance during their Introduction at the Opening Ceremony exceeds the time limit (3 minutes), each extra minute results in one Yellow Card. The extra time is rounded up to next minute. There are no penalties for exceeding the time allowed for presentations in the SFs where time is under control of the Chairperson who must stop the Phase when the time is up.

III. Results

1. The following values of grading parameters for the Teams (with penalties applied) are published as a table after each SF:

R, Rank;

SV, Sum of Victories;

TSP, Total Sum of Points;

V, Criterion of Victory for the most recent completed SF or all preceding SFs;

SP, Sum of Points for the most recent completed SF or all preceding SFs.

2. The following grading parameters are assigned to the Team that has not taken part in a SF: $SP=0$, $V=0$.

Chapter 4. Tournament Brackets

I. Selective Science Fights

1. For the three first Selective SFs, the Tournament Bracket established at the Opening Ceremony determines what Team competes in what Group and the sequence of performances in each Group.

2. The Tournament Bracket is established according to an exact procedure made public by the GC during the Opening Ceremony. The procedure involves drawing lots and aims at such a distribution of Teams among the Groups that the following criteria are respected when possible:

- a. no two Teams meet more than once prior to the Selective SF 4;
- b. no two Teams from one country meet at all;
- c. no Team competes in any Group more than once.

Below is given an exemplary Tournament Bracket of $N=15$ Teams, each from a different country, where the numbers indicate the Team index established by drawing lots. If N is a multiple of 3, the respective Bracket is established analogously. If N is not a multiple of 3, an analogous Bracket is established for the nearest next multiple of 3 ($N+1$ or $N+2$), followed by removing the extra entries. This and similar Tournament Brackets must allow each Team to be Reporters in all three possible Stages: Stage I, Stage II, and Stage III. The order of Teams in each Group determines the sequence of performances in Stage I.

SF	Selective SF Groups														
	A			B			C			D			E		
SF 1	1	6	11	2	7	12	3	8	13	4	9	14	5	10	15
SF 2	10	14	3	6	15	4	7	11	5	8	12	1	9	13	2
SF 3	12	5	9	13	1	10	14	2	6	15	3	7	11	4	8

3. In the Selective SF 4, the Teams are distributed among the Groups according to their Rank R after Selective SF 3. Below is given an exemplary Tournament Bracket of $N=15$ Teams, where the numbers indicate the Rank R . This and similar Tournament Brackets aim at separating top Teams from each other, such that they compete in different Groups. The sequence of performances in each Group is determined by the Captain's Contest.

SF	Selective SF Groups														
	A			B			C			D			E		
SF 4	R1	R10	R11	R2	R9	R12	R3	R8	R13	R4	R7	R14	R5	R6	R15

II. Semi-Final Science Fight

1. If the total number of Teams N is **12 or more**, then nine Teams having the highest Rank R after Selective SF 4 are allowed to the Semi-Finals in three Groups. The Tournament Bracket for the three Groups is given by the table below, where the numbers indicate the Rank R . The sequence of performances in each Group is determined by Captain's Contest.

Semi-Final SF Groups								
A			B			C		
R1	R6	R7	R2	R5	R8	R3	R4	R9

Only one Team from each of the three Semi-Final Groups is allowed to the Final SF. If there is more than one Team with $V=1$ in a Group, only one of such Teams is determined as a Finalist via comparison of Ranks R after Semi-Finals in the said Group only.

2. If the total number of Teams N is **8, 9, 10, or 11**, then six Teams having the highest Rank R after the Selective SF 4 are allowed to the Semi-Finals in two Groups. The Tournament Bracket for the two Groups is given the table below, where the numbers indicate the Rank R . The sequence of performances in each Group is determined by Captain's Contest.

Semi-Final SF Groups					
A			B		
R1	R4	R5	R2	R3	R6

If only two Teams have $V=1$ in the two Semi-Final Groups, both are allowed to the Finals, while the third Finalist is determined by the highest Rank R after Semi-Finals across both Groups. If three Teams have $V=1$ in the two Semi-Final Groups, all three are allowed to the Finals. If there are four or more Teams with $V=1$, only three of them with the highest Ranks R after Semi-Finals are allowed to the Finals.

3. If the total number of Teams N is **7 or less**, then the Semi-Finals are not carried out and the three Teams with the highest Rank R after the Selective SF 4 are allowed to the Finals.

4. Immediately after the announcement of the Semi-Finalists following the Selective SF 4, the Semi-Finalists select the problems for their reports from the set of main IYNT problems and problems *Invent Yourself*. Teams may not select the problem that they have reported in any preceding SF. All problems must be different, and the priority in the choice is determined by the Rank R after the Selective SF 4. The list of selected problems is made public.

III. Final Science Fight

1. Three appropriately determined Teams take part in the Final SF. The sequence of performances in the Final Group is determined by Captain's Contest.

2. Immediately after the announcement of the three Finalists, the Finalists select the problems for their reports from the set of main IYNT problems or the problems *Invent Yourself*. Teams may not select the problem that they have reported in any preceding SF. All problems must be different, and the priority in the choice is determined by the Rank R after the Semi-Finals (or, if the Semi-Final SF was omitted, by the Rank R after the Selective SF 4.) The list of selected problems is made public.

Chapter 5. Winners

I. Diplomas and Medals

1. Each Team Member and each Team Leader of the winning Teams receive an own Medal and an own Diploma. Official Diplomas of the IYNT must be signed by at least two Members of the GC.

2. One or several Finalists with $V=1$ in the Final SF are awarded 1st Place Diplomas and Gold Medals. Only one Team with the highest SP in the Final SF is declared Absolute Winner of the IYNT.

3. Other Finalists with $V \neq 1$ are awarded 2nd Place Diplomas and Silver Medals of the IYNT.

4. All other Semi-Finalists are awarded 3rd Place Diplomas and Bronze Medals of the IYNT. If the Semi-Finals are omitted (in case of 7 or less Teams in the IYNT), 3rd Place Diplomas and Bronze Medals of the IYNT are awarded to two Teams with the top Rank R that do not pass to the Finals.

II. Certificates

All other Team Members and Team Leaders receive Certificates of Participation for their Teams.

III. Final Ranking

The Final Rank (RF) for each Team is made public after the Finals and has integer values from 1 to N , where N is total number of Teams in the IYNT. For the three Finalists, it has values of $RF=1$, $RF=2$, and $RF=3$ according to the SP in the Finals (equal SPs are resolved by comparing Ranks R after the Semi-Finals.) For the Semi-Finalists that do not pass to the Finals, RF is determined via comparison of Ranks R after the Semi-Finals. For the Teams that do not pass to the Semi-Finals, RF equals the Rank R after the Selective SF 4. Final Rank RF is used to indicate the placing of a Team after the completion of the IYNT and the order in which Certificates and Diplomas are awarded at the Closing Ceremony, from bottom to top.

Chapter 6. Status of the Regulations

I. Authority, Authorship and Application

These Regulations supercede and replace any and all prior Regulations of the IYNT released by the GC of the IYNT and other Bodies in the past. By releasing these Regulations, the GC abrogates in particular the Regulations of the IYNT adopted and released on February 25, 2015. The Regulations are developed by Evgeny Yunosov. Contributions are made by Ilya Martchenko.

II. Effective date

These Regulations are adopted and take effect on September 5, 2015.

III. Future amendments

These Regulations are adopted and approved by the GC and can be amended or edited only by the GC. Unless a future GC decision abrogates these Regulations, they remain in force indefinitely.

September 5, 2015

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Foundation for Youth Tournaments

<http://iynt.org/foundation>

The Foundation is located in Moscow and is focused on promoting and developing youth intellectual competitions based on the framework of a scientific tournament.



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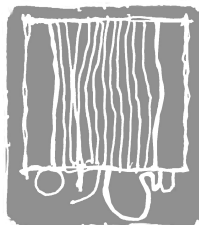
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Upload of solutions

In 2016, we use the upload manager *IYPT Solutions* in cooperation with the IYPT Archive. All teams must obtain login and password and upload their Reports, Oppositions, and Reviews before the Closing Ceremony.



1. Get an account: contact the IYNT Situation Center to obtain your team's username and password for *solutions.iypt.org*.

2. Prepare your files: there is no limitation imposed to the primary file types and to the number of files constituting one solution, one opposition, or one review. We collect primarily your slides, but we can also collect progress reports, videos, manuscripts, etc. As a rule of thumb we recommend to share both PDFs and the original files such as PowerPoint slides. We acknowledge that animations would be lost while the slides are converted into PDFs. Nevertheless, PDFs are more convenient for users and more resistant towards digital obsolescence and future incompatibility of software. We kindly request that all slides and reports should be duplicated as PDFs, when possible.

3. Upload: log in to *solutions.iypt.org*, save the names and contact emails of the authors, choose the necessary files on your local disk, and simply click *upload file*.

Schedule

July 16, 2016 — Saturday

Full day arrival
18h00–20h00 Welcome Dinner
20h30–21h30 Jury Meeting

July 17, 2016 — Sunday

06h00–07h30 Breakfast
08h00–11h30 **Opening Ceremony, Introduction of Teams, Drawing Lots**
12h00–13h30 Lunch
14h00–15h00 **Briefing for Jury, Teams**
15h00–18h00 **SF 1 (main problems)**
18h30–20h00 Dinner
20h00–21h00 Science+Art=Happiness

July 18, 2016 — Monday

06h00–07h30 Breakfast
08h30–09h00 **Briefing for Jury, Teams**
09h00–12h00 **SF 2 (main problems)**
12h00–13h30 Lunch
16h00–20h00 Excursion and dinner

July 19, 2016 — Tuesday

06h00–07h30 Breakfast
08h30–09h00 **Briefing for Jury, Teams**
09h00–12h00 **SF 3 (Invent Yourself)**
12h00–13h30 Lunch
14h00–14h30 **Briefing for Jury, Teams**
14h30–18h00 **SF 4 (addl problems)**
18h30–20h00 Dinner
20h30–21h30 Science+Art=Happiness

July 20, 2016 — Wednesday

06h00–07h30 Breakfast
08h30–09h00 **Briefing for Jury, Teams**
09h00–12h00 **Semi-Finals**
12h00–13h30 Lunch
15h00–21h00 Excursion and dinner

July 21, 2016 — Thursday

06h00–07h30 Breakfast
08h00–12h00 **Finals**
12h00–13h30 Lunch
14h00–18h00 Free time
18h30–20h00 Dinner

July 22, 2016 — Friday

07h00–08h00 Breakfast
08h30–10h30 **Closing & Award Ceremony**
Full day departure

Subject to revisions,
check for announcements



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