

Grand final
International Natural Sciences Tournament
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Problems of Grand final
XI International Natural Sciences Tournament
Block A

1. Vape me!

A special medical vaporizer is used in medicine for the treatment of some diseases, but one of its drawbacks is a large size. Nevertheless, it is well-known that vapes are in high demand and quite popular. Come up with an idea of how to use vapes in medicine. What diseases can be treated using them? What restrictions on the choice of active substances does this technology impose? Specify what liquid is to be used in the proposed medical vape and justify your choice. Quantify the concentration of one or more chosen medicinal substances in vapour and compare it to real values used in current medical practice.

Attention! The scientific council of the Tournament does not promote smoking e-cigarettes but suggests the participants reflecting on how to exploit the popular technology for the benefit of human health.

2. Macroplastics

Microplastics pollution in the ocean threatens marine life and the ecosystem. Simple methods of mitigating the pollution, based on microplastics filtration, have a number of serious shortcomings, they are even completely ineffective when dealing with plastic nanoparticles.

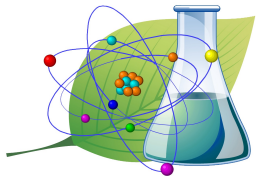
However, this problem would be solvable if the plastic particles could adhere to each other forming the larger fractions. Such fractions would be less harmful and easier to recycle.

Propose an idea of how to initiate a process of microplastics particles agglomeration chemically, physically, or biologically. The proposed solution should be applicable either globally or locally, *e.g.* on so-called garbage islands.

3. Ants for people

While sifting through the rubble, dogs are of invaluable assistance, but sometimes they cannot get close to the injured person, the smell of whom they have caught. Therefore, they cannot show rescuers the way to the person. Insects are much smaller in size, have a keen sense of smell and are sensitive to thermal radiation.

How can insects be used in search and rescue activities? Specify a signal, which can help insects to find a live person, and specify a way to transmit the precise and reliable signal to rescuers. Identify the limitations of your method.



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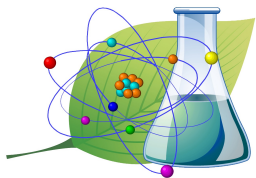
4. The masks

The coronavirus pandemic makes millions of people all around the world wear protective masks. However, the masks are used not only for protection from viruses and bacteria but also from toxins, various types of dust, *etc.* Suggest a mask model with an indicator that would change any noticeable for anyone characteristic in case of any mask dysfunction. The indicator mask model has to be safe in usage.

5. Grey goo

Grey goo is a hypothetical doomsday scenario associated with molecular nanotechnology achievements. It predicts that uncontrollable self-replicating nanorobots, carrying out their self-reproduction program, will consume all available Earth's material or biosphere substance that is biomass. This scenario is known as **ecophagy**.

Suggest a concept of a self-replication nanorobot, based on a real biological object modification, or a non-biological nanorobot capable of consumption/conversion of a certain common substance/material on the planet.



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Block B

6. TENET

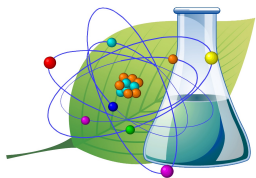
The increasing of carbon dioxide concentration in the atmosphere leads to faster plants growth and their greater uptake of this greenhouse gas. Besides, a high concentration of CO_2 lets plants survive in more arid regions due to the opening of the stomata for a short period of time and less waste of water during the respiration process. Thus, the increase in greenhouse gas concentrations can have merits. Propose any other global effects of the increase in CO_2 concentrations which can be considered beneficial for humanity. Describe the mechanisms of this impact and its long-term prospects.

7. Phoenixes

Using solar power towers is a promising way of electricity generation. However, these power plants can cause the death of birds flying over them. Bright light makes these towers attractive to insects, which attract birds in turn. The birds ignite in midair and die. The problem is quite urgent for the stations located near migration routes of protected species. Propose a way to scare birds away from the power towers which will not affect their energy efficiency.

8. Lignin park

According to the International Lignin Institute data, only a few percent of lignin are used for industrial needs. The majority of this paper industry waste is buried in landfills and can ignite. However, as new data on biodegradation has appeared, the interest in this material has lately increased. In this way, lignin is now considered to be an alternative to plastic. Scientific American considered the production of lignin-based plastic materials as one of the most emerging technologies of 2019. Propose possible ways of using lignin wastes as a material for household items. Articulate the key steps of lignin transformation. Keep in mind that your technology has to comply with requirements to biodegradable materials and be scalable. The demonstration of your technology will be an advantage.



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9. *Terra incognita*

The human immune system is an elaborate combination of various processes and phenomena. Lately, several scientists have been dignified with Nobel prizes for having made many fascinating discoveries in this field. Explain the possibility of reinfection with any chosen pathogen even if the antibodies of different types were formed. Highlight the key factors which can affect it. Does any method or natural mechanism to avoid a decline in antibody levels over time exist? Is the presence of antibodies a sufficient parameter to conclude that a person is immune?

10. *Pro et contra*

Modern society is obsessed with the idea of "organic products". Propose the most suitable in your opinion wording for this concept. Point out the pros and cons of organic products in terms of human health, environment, and agriculture economics.

The Grand final of the XI INST will be held online using videoconferencing software. The tournament dates are July 19–26, 2021. 10 Grand final problems will be presented, with 5 in each block. The distribution of the blocks in days and the detailed schedule of the tournament will be published no later than July 12, 2021. The scheme of this year online Grand final is the same as it is described in the [Rules&Regulations](#).

The participation fee for every team is €65. Teams should inform the Organizing committee about their desire to participate in the Grand final no later than July 5, 2021. The deadline for the fee payment is July 11, 2021.

If you have any questions with regards to the presented information, please, do not hesitate to contact the Teams' coordinator Polina Lavrik via participants@scitourn.com.

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