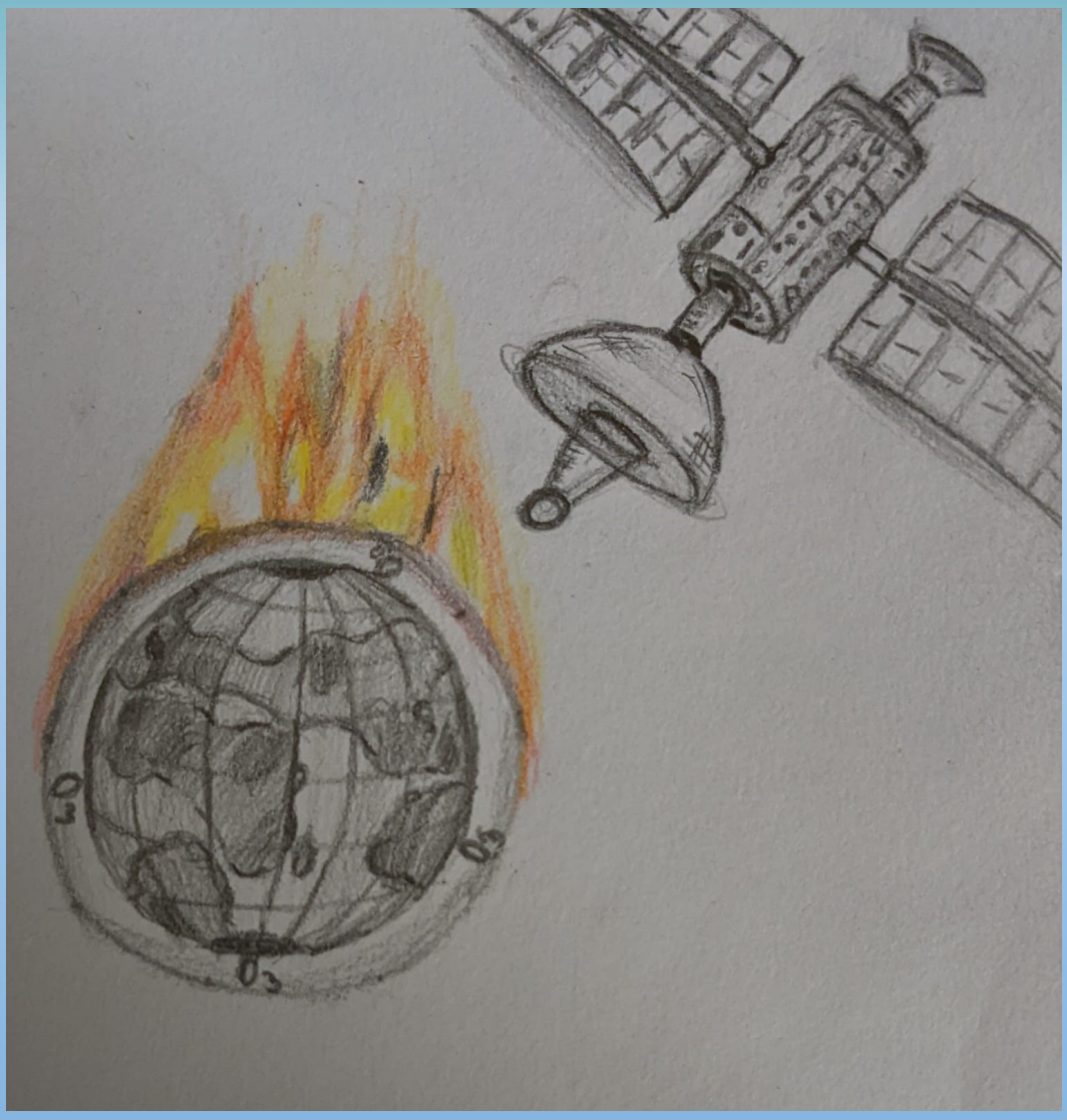
Ambassadors of sustainability



The XII –th A Grade

„Octavian Goga ” National College in Sibiu

October 06, 2022

Săptămâna mondială a spaţiului cosmic 4 - 10 octombrie 2022

Săptămâna mondială a spaţiului cosmic este un eveniment internațional desfășurat sub auspiciile Organizaţiei Naţiunilor Unite, în perioada 4 - 10 octombrie 2022, având ca temă „Spaţiul şi durabilitatatea".

Activitățile, desfășurate în cadrul acestui eveniment de elevii clasei a XII-a A de la Colegiul Național „ Octavian Goga”, în data de 6 octombrie 2022, au constat în propunerea unor sugestii pragmatice de acțiune globală pentru realizarea unor obiective de dezvoltare durabilă regăsite în Agenda 2030 propusă de Națiunile Unite precum: acțiuni de combatere a schimbărilor climatice și a impactului acestora (prevenirea efectelor dezastruoase ale încălzirii globale), de reducere a emisiilor de CO2 (de exemplu, prin sisteme orbitale de curățare a reziduurilor), obținerea de energie curată la prețuri accesibile, managementul durabil al apei în general (prin conservarea și utilizarea durabilă a oceanelor, mărilor și resurselor marine) și al apei potabile în special, consumul și producția responsabilă, dezvoltarea orașelor și comunităților durabile etc.

ELEVII PARTICIPANȚI LA PROIECT

AVRAM ELENA
BLEMOVICI DARIUS
CĂZAN EVA
CHICHIOACĂ MARIA
CIOABĂ ALEX
CÎRȚOROȘAN DIANA
CODIN IULIA
COSTĂCHESCU VICTOR
DORDEA MEDEEA
DRAGOMIR DIANA
FLOCA ANA
HANZELLI MICHELLE
HAȚEGAN ADA
ILCUȘ ANDRA
IVAN ANDREEA
IAKOB ANDRA
MITEA DARIA
MOROȘAN SARA
NEAGA ALEXIA
PAȘCALĂU DIANA
POPA ROBERT
POPICA DANIELA
PORIME ROBERT
PURȚA CARMINA
RADU ANDREEA
ROȘCA ANA
STREINU ANDREEA
STREULEA VALENTINA

Coordonator de proiect: prof. diriginte, Ramona Vișan

Space and Sustainability

By Blemovici Darius, Chichioaca Maria, Codin Iulia, Mitea Daria, Streinu-Buta Andreea
12th Grade, Colegiul National Octavian Goga Sibiu, Romania

Problem Addressed: Space junk in LEO, MEO, and GEO.

As we all know it, every space launch generates some type of space junk. Even though the modern mission profiles account for the destruction of the upper stages of the rocket by de-orbiting it (if possible, depending on the mission profile), it hasn't always been that way. And taking into account the countless nonoperational satellites in different orbits around the globe, it adds up to a lot of space junk to take care of. And one might ask, why do we care so much if it doesn't even affect our lives? Well, it does, and it is only a matter of time until it could become catastrophic. The problem is that because of the vast amount of space junk in orbit, it only takes a few unlucky events to create a chain reaction that could make outer space unreachable. That is because an insignificant space collision will create a debris cloud moving at staggering speeds on different orbital trajectories, making the next collision ever so slightly more possible. And it is only a matter of time until the next collision happens, hitting even more space junk or even worse, operational satellites, creating a sort of blanket of very fast-moving space debris that is very hard to penetrate. Not to mention that every service that relies on satellites will become inoperable since no satellites can survive in orbit.

That is where our preposition comes into play: eliminate the very space junk that could cause all of this until it is not too late. Of course, this is nothing new, and has been thought of many times before, but until now no reliable and scalable solution exists. We, as mere students, can only come up with ideas regarding how such task can be achieved. And from the get go, space lasers are not an option (sorry for Sci -fi fans out there). This means that there has to be a physical object that has to get up to the space junk, rendezvous with it, capture it, and bring it into the Earth`s atmosphere to burn up. This is no easy task, since many of these space debris are in very high orbits, and are very heavy, meaning that they need a lot of ΔV to bring down. That means that basically all of the traditional rockets are out of the equation, since they do not meet the necessary weight and efficiency requirements of the mission plan. We have to rely on something a bit more efficient. This is where Ion thrusters come into play. They offer a very high ISP, meaning that they are very efficient, and are somewhat light compared to the classical rocket engines. But this efficiency comes at a cost: their tiny thrust. But this is no problem because the de-orbit burn can happen in multiple passes at the apoapsis, negating the need for a high TWR. These supposed objects that deorbit the junk also have to be light and small in size, in order to launch multiple of them at the same time. They also have to be completely autonomous, so that they can rendezvous and capture the space junk by itself, negating the need from ground control to constantly check telemetry and make the necessary adjustments to the orbit; its like launch and forget! These satellites can be launched by the up-coming

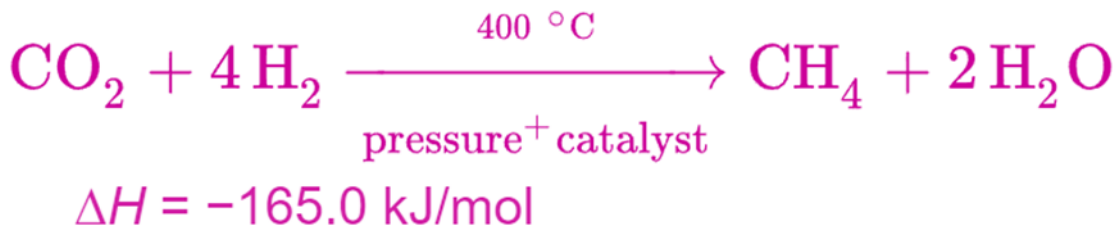
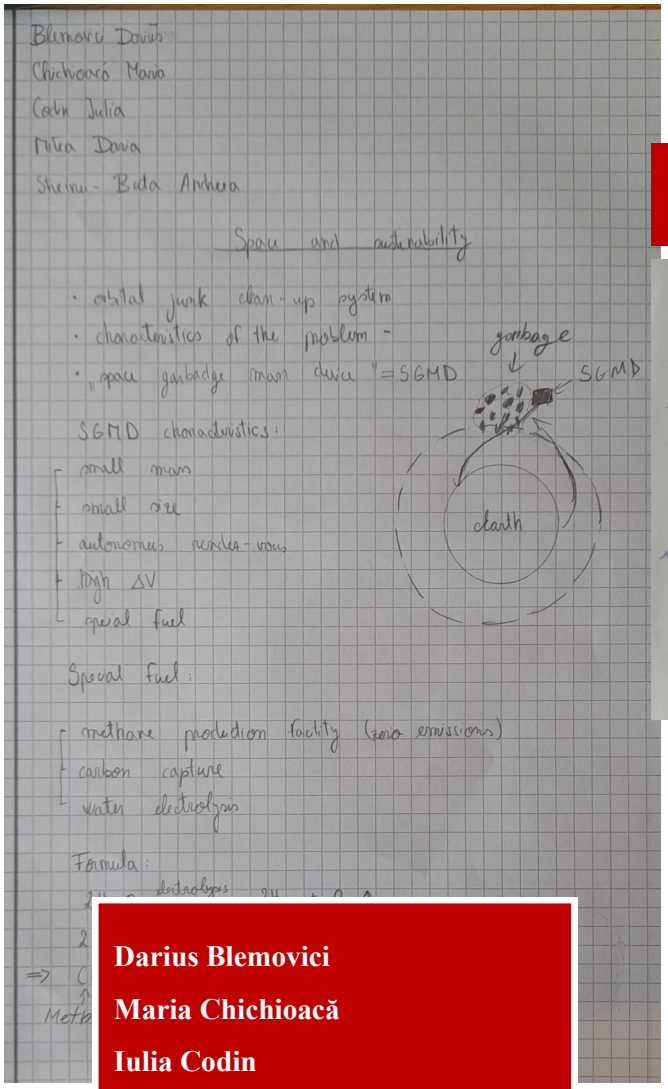


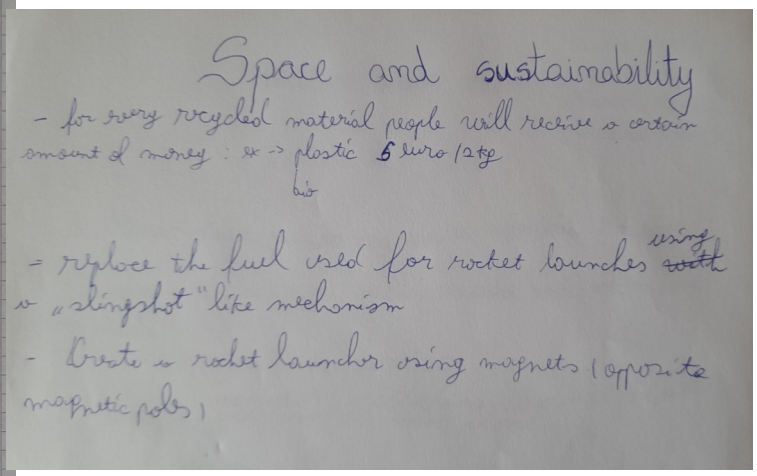
Image source: https://en.wikipedia.org/wiki/Sabatier_reaction

The only byproducts of the two reactions are oxygen and water, which can be used for electrolysis once again. To power all these processes, we need a lot of power, which can be sourced from our neighboring star, the Sun (using solar panels), and to get the necessary 400^0C for the reaction to take place we can focus the Sun`s light using multiple mirrors and bypassing the need to convert that energy to electricity and then back into heat, maximizing the efficiency. This way, we can remove carbon from the atmosphere, and then when the methane is burnt by a rocket it is released back into the atmosphere, resulting in a net 0 increase in carbon emissions. We basically transform the solar energy into rocket fuel, with no further emissions, at a very inefficient rate. But even though it is very inefficient, if scaled to a industrial size, it can produce methane to power rockets basically for free.

All things considered, the cost to setup such a facility would be extremely high, as it uses very high-tech components and materials, but as with any investment, the return to profit comes after many years. And most importantly, any source of renewable energy could be used, not necessarily solar power. Another way the methane could be used is as a battery to store renewable energy. Excess energy that is produced during the day could be converted into methane and easily be stored, and be burnt to produce electricity during the night, thereby eliminating the need for lithium batteries, which are a non-renewable asset. All be it, this process is very inefficient compared to simply storing the energy into batteries, but keeping the limited amount of lithium for more important uses such as building electric cars, where the Sabatier process cannot be used, could help even out the ups and downs in renewable energy production in a new way.



Darius Blemovici
Maria Chichioacă
Iulia Codin
Daria Mitea
Andreea Buta– Streinu



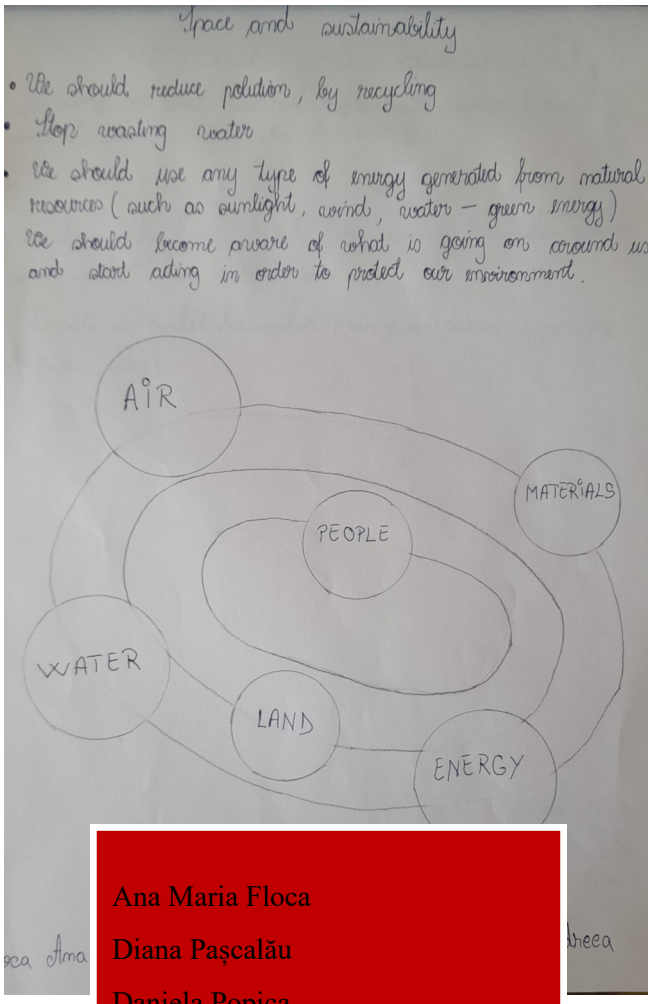
Elena Avran, Sara Moroșan, Robert Popa, Robert Porime

SpaceX Starship into a swarm, that then each goes to its specific target and brings it down to earth. Of course, it is much easier said then done, and there is a lot to take into account, for example if the AI that controls the space-cleaners crashes or makes wrong calculations in the approach, It could slam itself into the space junk, and we can create the very problem we are trying to fix.

All things considered, I believe that this issue is of great importance, and there has to be interest in solving it because all of the Sci-fi movies that we all love and dream about could become just that: movies that can never become reality. Not to mention the major setback for humanity as more and more services rely on satellite communication.

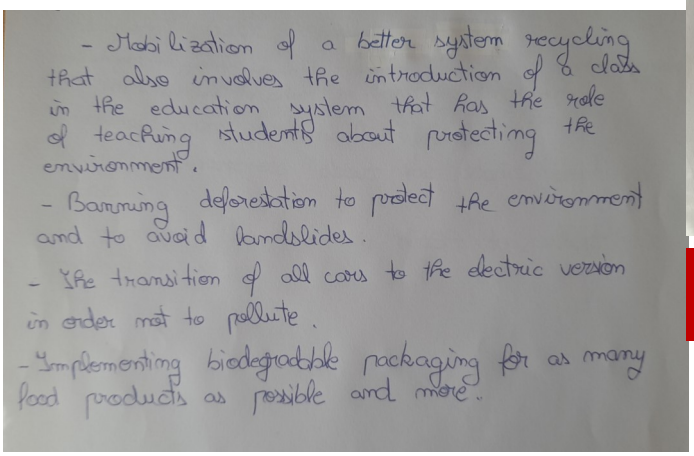
Problem Addressed: Environmentally sourced Methane for the space industry

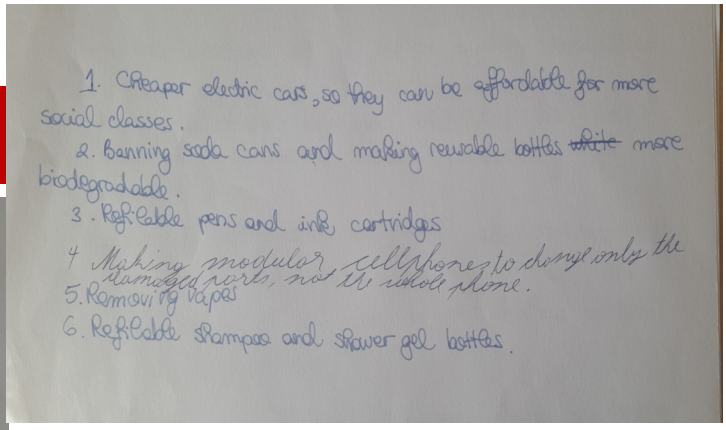
Methane is starting to pop up more and more in the space industry as it is an arguably better fuel type, for a couple of reasons. Firstly, it has a much closer freezing point in regards to oxygen than hydrogen does. This means that there can be a smaller amount of insulation between fuel tanks and oxidizer tanks and the walls of the tank to keep the fuel below its liquid point. Secondly, it burns much more cleanly than its counterpart, rocket grade kerosene, which deposits a lot of soot in the engines injectors and combustion chamber, making the reuse of these engines not worth the cost and time (exception: SpaceX` Falcon 9, which uses an open cycle kerosene engine that is refurbished after every launch) . Indeed, the engine cycle does play a big part in this argument, but open cycle engines (that are required for kerosene) already have a smaller ISP than their closed cycle counterparts. And most importantly, methane is much easier to store, keep pressurized, and keep it from leaking from the fuel and oxidizer pumps, as well as any other piping on the rocket, because it has a much bigger molecule than hydrogen, which likes to escape from every minuscule gap in every gasket. And even though it has so many benefits, methane also has some drawbacks. Methane does have a smaller ISP than its two counterparts, having a theoretical limit of “only” 458.7s, hydrogen having a whopping 532.5s, and kerosene having 470.2s. Of course, these are theoretical limits, and the actual ISP of the engine varies greatly with the cycle of the engine, design and the atmospheric pressure around the engine. So, with all things considered, where do we get this methane, if not from the oil deposits inside of earth? Well, the answer could be all around us. Literally. As we all might know, the formula for methane is CH4. That means that we somehow need to find hydrogen to react with some carbon atoms. And because we all complaint about the high levels of CO2 in the atmosphere, we will source our carbon from there. All we need is now hydrogen, which is the building block for earths most important resource: water. By running water through electrolysis, we can split the water into its building blocks, oxygen and hydrogen, expel the oxygen as we don’t need it, and make the hydrogen react with CO2 captured from the atmosphere to create our lovely rocket fuel. This process is called the Sabatier reaction. See the reactions below:



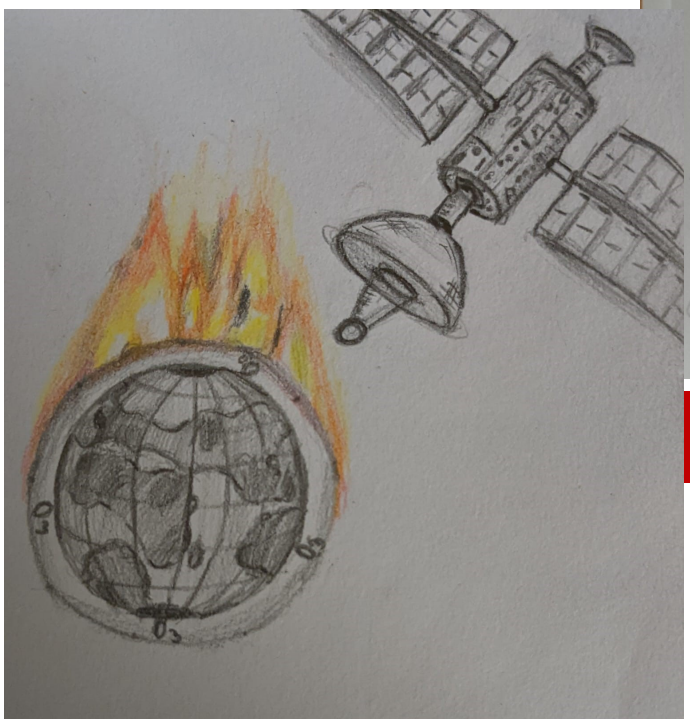
Ana Maria Floca
Diana Pașcalău
Daniela Popica
Andreea Radu

Ana Roșca, Andreea Ivan, Andra Ilcuș, Alexia Neaga

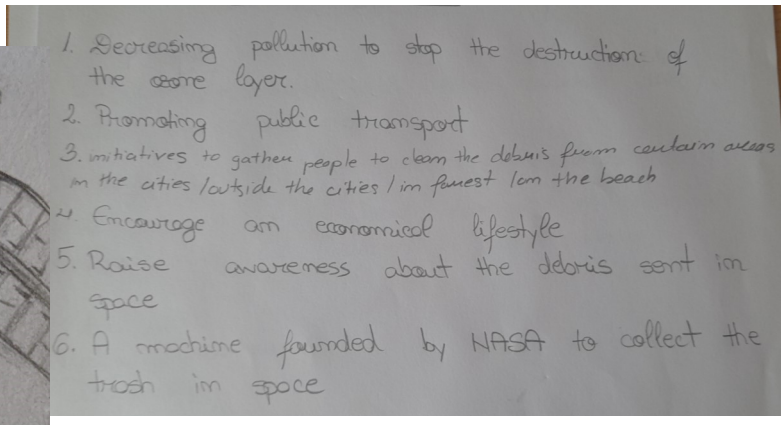

- Mobilization of a better system recycling that also involves the introduction of a class in the education system that has the role of teaching students about protecting the environment.
- Banning deforestation to protect the environment and to avoid landslides.
- The transition of all cars to the electric version in order not to pollute.
- Implementing biodegradable packaging for as many food products as possible and more.


1. Cheaper electric cars, so they can be affordable for more social classes.
2. Banning soda cans and making reusable bottles ~~white~~ more biodegradable.
3. Refillable pens and ink cartridges
4. Making modular cellphones to change only the damaged parts, not the whole phone.
5. Removing vapes
6. Refillable shampoo and shower gel bottles.

Medeea Dordea, Victor Costăchescu, Michele Hanzeli, Valentina Streulea

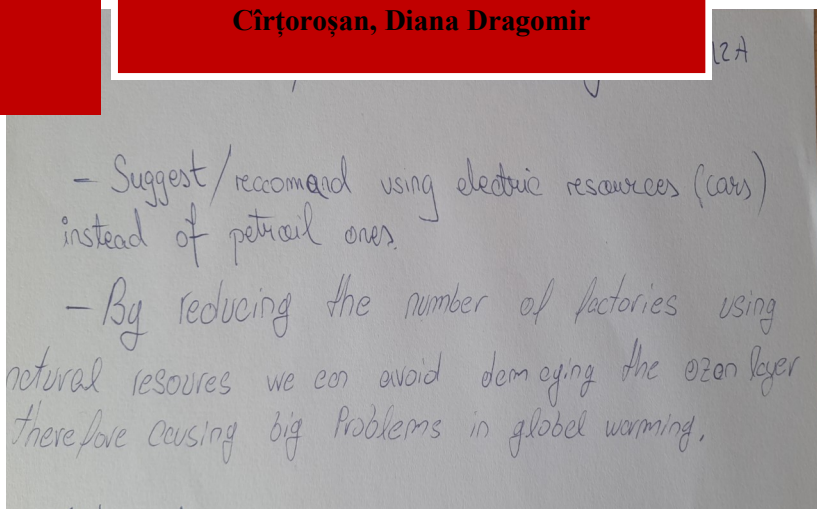


Ilustrație: Diana Cîrțoroșan


1. Decreasing pollution to stop the destruction of the ozone layer.
2. Promoting public transport
3. initiatives to gather people to clean the debris from certain areas in the cities / outside the cities / in forest / on the beach
4. Encourage an economical lifestyle
5. Raise awareness about the debris sent in space
6. A machine founded by NASA to collect the trash in space

Eva Căzan, Ada Hațegan

Andra Iakob, Alex Cioabă, Diana Cîrțoroșan, Diana Dragomir


- Suggest/reccomand using electric resources (cars) instead of petrail ones.
- By reducing the number of factories using natural resources we can avoid demaging the ozon layer therefore causing big problems in global warming.