

STEP 1. Identify Challenges

Read the Future Scene carefully and generate ideas for challenges, concerns, and possible related problems. Choose the 16 most important challenges and write them in the space provided

1	Because Ganymede's environment is manufactured to maximize efficiency, there might be a lack of diversity between the landscapes of the settlements, which will give less beautiful environments to provide inspiration for unique art and architecture.
2	Because voters use scanable votepasses to vote without further identification, voter fraud may occur, causing a candidate that does not have the majority support to win the election.
3	Because Blair (a candidate for President of Ganymede) has business interests in the hoverpod industry, if elected he may favor that business interest over the best interests of his constituents, causing harm to Ganymede's citizens through government corruption.
4	Because in Ganymede an emphasis is placed in each person doing their part, tensions could rise in relationships if some people feel that they are contributing more than others leading to the negative effects of tense relationships (such as an increased rate of depression).
5	Because Ganymede's society highly emphasizes the value of productive work, the population may feel pressured to work more than they would have on earth, causing a decrease in time spent relaxing or having fun with family.
6	Because the increased radiation exposure effecting people on Ganymede is causing "new illnesses", research previously done on Earth may not lead to effective treatment of these illnesses, threatening the physical health of Ganymede's citizens.
7	The widespread loss of vision and negative effects of gravity may decrease the production capability of Ganymede's human capital leading to a contraction of the economy as indicated by a leftward shift in the long run aggregate supply curve which would be accompanied by a decrease in general well-being due to high unemployment and an unhealthy economy.
8	Because the day/night schedules are reliant on man-made sun mirrors, a disruption in these mirrors possibly caused by the change in Ganymede's rotation could throw off the circadian rhythms of the citizens of Ganymede leading to weight gain, impulsivity, and slower thinking.
9	Because Ganymede is small and self-sufficient, there may be a shortage of able and healthy workers in the event of mass illness or natural disaster, causing essential producers to operate below the capacity needed to fulfill the citizens of Ganymede's basic needs.
10	Because citizens of Ganymede are experiencing the adverse effects of low gravity such as the increased rate of bone mass loss, more citizens of Ganymede may develop osteoporosis leading to an increase in broken bones.
11	Because Blair (a Ganymede presidential candidate) uses rhetoric such as "We can't afford to have people here who aren't doing their fair share", a meritocracy may develop under his leadership that only places value on quantifiable achievements rather than the wide range of skills that a society needs to function.
12	Because Blair and Ganymede First are under the impression that no one on Ganymede cares about statistics and scientific research, government funding may be allocated more to technological research, causing the Ganymede's students to suffer from poor education.

13 Because protection patches do not fully combat the adverse effects of radiation, pantropy or genetic mutation may be seen as the only way to maintain the physical health of Ganymede's citizens leading to a developed god complex and the excessive editing of genes and the possible extinction of future beneficial genes.

14 Because only the questions that get upvoted the most are answered by the candidates, this may cause some of the concerns of minority populations to go unaddressed leading to a government that prioritizes the majority and leaves the minority feeling marginalized and oppressed.

15 Because rotation engineering is a new technology, it may impact more aspects of the environment than just the temperature of the atmosphere, like changing the rotational velocity of the planet which would increase or decrease the length of a day, as a result, Ganymede could be subject to irreversable environmental consequences.

16 Because the founders of Ganymede have the chance to create a new form of government which differs from that of what was originally on planet earth, there may be some confusion from the new citizens of Ganymede of what is the law and what isn't, as a result, people may accidentally break the law without the new knowledge of what they can and can't do

STEP 2. Identify the Underlying Problem

Using the challenges listed in Step 1, identify a problem of major importance to the Future Scene situation. Write your Underlying Problem making sure your question clearly explains the action that will be taken and the desired results/goal of that action.

Because the negative physiological and mental health effects such as vision loss and psychological distress due to living in Ganymede's terraformed environment reduces the wellbeing of its citizens, how might we reduce the negative health effects of living on Ganymede on its citizens, so that they can lead more fulfilling lives in 2045 and beyond?

STEP 3. Develop Solutions

Generate solution ideas to the Underlying Problem in Step 2. Choose the 16 most effective solutions and write the elaborated ideas in the space provided.

1 Beginning in 2045, the Norris Research group will partner with recreational therapists on Ganymede to create aerogel bubbles near the six settlements, following the Worldhouse Concept, that would replicate various habitats and environments similar to those on earth (e.x a lake, a beach, the dessert, a rain forest, e.t.c) in order to combat some of the psychological stress that comes from being placed in a new environment. Because reducing stress has a positive impact on illness, this will increase their overall wellbeing and allow citizens to live fulfilling lives.

2 Beginning in 2045, Influencers such as Evie Kubota will start a national campaign focused on emphasizing the importance of art in society by painting murals in the settlements that depict scenes that inspire citizens to create their own art. This will improve the mental health of those that create art and of those that view the murals, which will help counter the negative effects of the stress of living in Ganymede's environment and help its citizens lead happier, more fulfilling lives.

3 Beginning in the year 2045, Ganymede's scientists will partner with NASA's scientists and develop the existing technology developed by NASA to create stronger protective patches using more dense (perhaps layered or woven) materials to combat the negative effects of radiation currently experienced by the citizens of Ganymede on Ganymede. This will reduce the incidence of illness due to the environment, allowing citizens to lead healthier, more fulfilling lives.

4 Beginning in 2045, CRISPR Therapeutics will work with doctors on Ganymede who are familiar with the adverse effects Ganymede's citizens are experiencing to target genes responsible for factors such as bone density or vision problems that are exacerbated by Ganymede's environment with gene therapies in utero, replacing these genes with modified versions that provide for features that are more suited to Ganymede's environment. Citizens already impacted by degenerative health problems will still benefit from this project, as an understanding of the illnesses causes will help the doctors collaborating with CRISPR to create more effective restorative treatments. This approach will reduce the negative effects of the environment on citizen's health because future citizens will be better adapted to their environments and current citizens will have better access to restorative care, so they will be able to live more fulfilling lives with less health problems.

5 Beginning in the year 2045, Therapists on Ganymede will partner with Flotation Therapy center owners to create a meditation center that focuses on using the lack of gravity on Ganymede to allow citizens to float in a dark quiet room in order to provide improvements of the psychological health of citizens in order to give them a chance to relax and destress, leveraging the positive aspects of environmental change when living on Ganymede to counter the decreasing the negative effects on mental health due to the newly terraformed environment, and allowing citizens to lead more fulfilling lives.

6 Beginning in 2045, the Ganymede education system will partner with artists and graphic designers at Zebradog to create infographics with significant statistics about health on Ganymede in order to educate its students on their environment. This will empower them to make informed decisions about their leadership with their own well-being in mind and create an internal locus of control which has been shown to increase overall well being especially feelings of self efficacy and mood.

7 Beginning in 2045, hoverpods will be modified by the Ganymede government to include compact excersize equipment, allowing people to move around during transportation in order to combat the degenerative effects of sitting still for long periods of time and the lowering of bone mass, which are exacerbated due to the low gravity of Ganymede.

8 Beginning in 2045, ICREA-Complex Systems Lab will partner with scientists on Ganymede to create bioengineered organisms (pets adapted to Ganymede conditions) that would act as a therapy animal to citizens of Ganymede, and also be able to contribute to maintaining the healthy atmosphere by collecting the carbon dioxide released by humans and transforming it into oxygen, in order to not only reduce the stress of citizens on Ganymede due to the terraformed environment, but also improve the terraformed environment for Ganymede, thus allowing citizens to lead more fulfilling lives.

9 Beginning in 2045, the National Eye Institute will partner with the government of Ganymede to develop and provide inexpensive eye exams, eye-glasses, and laser eye surgery to citizens in order to fix any vision losses from the effects of low gravity. Through research conducted on Ganymede, they will create vision treatments that reduce deterioration of sight, which will allow Ganymede's citizens to live more complete lives, like they would on Earth.

10	Beginning in 2045, Ganymede's scientists will use in situ resource utilization and synthesis reactions between iron from the core and the abundant oxygen to produce iron oxide gas which is denser than the gasses in Ganymede's current atmosphere. This denser atmosphere will block more of the harmful radiation from the sun in order to lessen the radiation exposure experienced by the citizens of Ganymede, reducing health consequences due to radiation and helping them live more fulfilling lives.
11	Beginning in 2045, the citizens of Ganymede who lost loved ones in the gany shuttle disaster will form support groups in order to work through their common grief caused by their unusual environment and improve their psychological well-being, which will allow them to feel at peace and be more fulfilled with their lives.
12	Beginning in 2045, businesses on Ganymede will incorporate a mental health time during the day to encourage their employees to prioritize their psychological well being in order to combat some of the psychological distress caused by the unique challenges of Ganymede's environment.
13	Beginning in 2045, both political parties of Ganymede will agree to decrease their negative rhetoric, such as the possible catastrophic effects of rotation engineering, in order to decrease stress experienced by the citizens of Ganymede related to the political climate.
14	Beginning in 2045, the government of Ganymede will increase its spending on anti-radiation research to increase aggregate demand, boosting its economy and increasing GDP per capita which studies show is linked to better medical care and lower rates of depression, in order to help its citizens lead more fulfilling lives.
15	Beginning in 2045, the Ganymede government will mandate that all schools have walls lined with iron, a dense material that decreases radiation in order to provide children with a lower-radiation learning environment and decrease the likelihood that they will develop a radiation-related illness allowing the children to live more fulfilling lives.
16	Beginning in 2045, the ARRL (American Radio Relay League) will partner with the government of Ganymede to create a program that will provide all citizens within the six settlements that have a radiation-based sickness fast and low-cost communication between their doctors and their places of work in order to decrease the time between diagnosis of radiation sickness and time of treatment, which will decrease the mortality of such illnesses.

STEP 4. Generate Criteria

Generate criteria to determine which solution idea does the best job of solving the Underlying Problem and/or addressing the Future Scene situation. Select the 5 most important criteria for measuring solution ideas and write them in the spaces provided.

1	Which solution will most reduce the negative health effects of living on Ganymede?
2	Which solution will best help Ganymede's citizens live more fulfilling lives?
3	Because Ganymede's economy relies on its citizens contributions to run efficiently, which solution will enable the most citizens to be productive members of the economy?
4	Because the effects of Ganymede's environment sometimes impact projects in unpredictable ways (such as ocean-based electrical transmissions being impacted by undetermined crust thicknesses), which solution will be most adaptable to changing knowledge about Ganymede's environment?
5	Because citizens are already suffering from health issues due to the terraformed environment of Ganymede, which solution will be able to be implemented the quickest?

STEP 5. Apply Criteria to Solutions

From the solution ideas written in Step 3, select the 8 ideas with the most potential to solve the Underlying Problem and list them on the grid. Use each criterion to rank the solutions on a scale from 1 (poorest) to 8 (best). The numerical ranking for one important criterion may be doubled.

Rank solutions.

						Criteria	
#	Solution	1	2	3	4	5	Total
1	Beginning in 2045, the Norris Research group will partner with recreational therapists on Ganymede to create aerogel bubbles near the six settlements, following the Worldhouse Concept, that would replicate various habitats and environments similar to those on earth (e.x a lake, a beach, the dessert, a rain forest, e.t.c) in order to combat some of the psychological stress that comes from being placed in a new environment. Because reducing stress has a positive impact on illness, this will increase their overall wellbeing and allow citizens to live fulfilling lives.	7	5	7	5	2	26
2	Beginning in 2045, Influencers such as Evie Kubota will start a national campaign focused on emphasizing the importance of art in society by painting murals in the settlements that depict scenes that inspire citizens to create their own art. This will improve the mental health of those that create art and of those that view the murals, which will help counter the negative effects of the stress of living in Ganymede's environment and help its citizens lead happier, more fulfilling lives.	3	1	6	2	8	20
3	Beginning in the year 2045, Ganymede's scientists will partner with NASA's scientists and develop the existing technology developed by NASA to create stronger protective patches using more dense (perhaps layered or woven) materials to combat the negative effects of radiation currently experienced by the citizens of Ganymede on Ganymede. This will reduce the incidence of illness due to the environment, allowing citizens to lead healthier, more fulfilling lives.	4	7	1	3	1	16

4	<p>Beginning in 2045, CRISPR Therapeutics will work with doctors on Ganymede who are familiar with the adverse effects Ganymede's citizens are experiencing to target genes responsible for factors such as bone density or vision problems that are exacerbated by Ganymede's environment with gene therapies in utero, replacing these genes with modified versions that provide for features that are more suited to Ganymede's environment. Citizens already impacted by degenerative health problems will still benefit from this project, as an understanding of the illnesses causes will help the doctors collaborating with CRISPR to create more effective restorative treatments. This approach will reduce the negative effects of the environment on citizen's health because future citizens will be better adapted to their environments and current citizens will have better access to restorative care, so they will be able to live more fulfilling lives with less health problems.</p>	<p style="text-align: center;">8 6 5 8 5</p>	<p style="text-align: center;">32</p>
5	<p>Beginning in 2045, the National Eye Institute will partner with the government of Ganymede to develop and provide inexpensive eye exams, eye-glasses, and laser eye surgery to citizens in order to fix any vision losses from the effects of low gravity. Through research conducted on Ganymede, they will create vision treatments that reduce deterioration of sight, which will allow Ganymede's citizens to live more complete lives, like they would on Earth.</p>	<p style="text-align: center;">5 8 8 6 3</p>	<p style="text-align: center;">30</p>
6	<p>Beginning in 2045, the Ganymede education system will partner with artists and graphic designers at Zebradog to create infographics with significant statistics about health on Ganymede in order to educate its students on their environment. This will empower them to make informed decisions about their leadership with their own well-being in mind and create an internal locus of control which has been shown to increase overall well being especially feelings of self efficacy and mood.</p>	<p style="text-align: center;">1 2 4 7 7</p>	<p style="text-align: center;">21</p>
7	<p>Beginning in 2045, hoverpods will be modified by the Ganymede government to include compact excersize equipment, allowing people to move around during transportation in order to combat the degenerative effects of sitting still for long periods of time and the lowering of bone mass, which are exacerbated due to the low gravity of Ganymede.</p>	<p style="text-align: center;">2 3 3 4 6</p>	<p style="text-align: center;">18</p>
8	<p>Beginning in 2045, ICREA-Complex Systems Lab will partner with scientists on Ganymede to create bioengineered organisms (pets adapted to Ganymede conditions) that would act as a therapy animal to citizens of Ganymede, and also be able to contribute to maintaining the healthy atmosphere by collecting the carbon dioxide released by humans and transforming it into oxygen, in order to not only reduce the stress of citizens on Ganymede due to the terraformed environment, but also improve the terraformed environment for Ganymede, thus allowing citizens to lead more fulfilling lives.</p>	<p style="text-align: center;">6 4 2 1 4</p>	<p style="text-align: center;">17</p>

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STEP 6. Develop Action Plan

Develop your top-scoring solution idea into an Action Plan. Thoroughly explain how the Underlying Problem is solved, how the plan will be implemented, and how the Future Scene will be affected.

Beginning in 2045, CRISPR Therapeutics will partner with doctors on Ganymede who are familiar with the adverse effects Ganymede's citizens are experiencing to collaborate on a pantropy project targeting genes responsible for factors such as bone density or vision problems that are exacerbated by Ganymede's environment with gene therapies in utero, replacing these genes with modified versions that provide for features that are more suited to Ganymede's environment. Citizens already impacted by degenerative health problems will still benefit from this project, as an understanding of the illnesses causes will help the doctors collaborating with CRISPR to create more effective restorative treatments. This approach will reduce the negative effects of the environment on citizen's health because future citizens will be better adapted to their environments and current citizens will have better access to restorative care, so they will be able to live more fulfilling lives with less health problems.

The first stage of the project (conducted within the 1st 9 months) will be genetic research conducted completely on Ganymede. Doctors and CRISPR Therapeutics researchers will compare the lifestyles and genes of citizens who are more adversely impacted by Ganymede's environment with those who don't experience chronic health problems. This will help researchers isolate genetic traits that are more well-suited to Ganymede's environment. For those who are already impacted by a chronic condition, this will help researchers develop treatment for the illness by knowing the cause (eg: genetic inflammatory issues or respiratory problems that, when treated, could help the underlying illness). For those who are not yet effected, they can be tested for common genetic markers that put them at a higher risk of developing illness on Ganymede (like how people are tested for BRCA 1 and 2) and begin therapies and exercises to reduce the progression of the illness.

The second stage of the project will involve clinical trials where the genes of embryos that display traits that put them at high risk for developing health problems in Ganymede's environment are replaced with healthy versions of the gene. This trial will be completely optional to participate in if parents test positive for genes that would put their child at high risk, and no genes that aren't linked to specific health problems will be edited.

Once trials are proved to be safe and effective, this gene-editing will be available to the public on Ganymede. Potential ethical concerns with this type of gene editing include lack of access for families with less money and a potential for discriminatory gene editing that limits diversity. To circumvent these problems, politicians on Ganymede will work to establish a public healthcare fund that will cover the costs of illness-related genome editing, and CRISPR Therapeutics will not extend genome-editing options beyond what is necessary to ensure that the embryos being edited are able to live full, healthy lives on Ganymede. Even if only a small number of at-risk genes are swapped for healthy genes, those people will grow up to have kids that carry healthy, Ganymede-friendly genes, which will improve the overall health of Ganymede's society over time.

While some may say that this sort of gene-editing manipulates Ganymede's citizens into being more adapted to Ganymede than Earth and limits immigration back to Earth, this change would likely happen over time due to evolution, and providing the option for genome editing means that fewer people have to experience the negative impact of these genes in order for them to be overcome in the gene pool, and fewer people will die young due to these problems.

Becoming more suited to Ganymede's environment reduces its negative affect on its citizens, and reduces the need for other interventions such as surgery or drugs, which have side effects and recovery periods that can be painful and reduce someone's quality of life. By being more suited to their environment and ameliorating these negative health effects, people in Ganymede will live lives less dictated by the constraints of their environment, which will allow them to focus on creativity, empathy, and innovation, as was their goal in founding Ganymede. This reduced loss of citizen time and energy to their health problems also allows for economic expansion as they will be more productive when they feel better and take less sick days. This economic growth will also help sustain the costs of the genome-editing program so that neither the people nor the government need to go in debt to support the cause.

Finally, conducting all of the trials on Ganymede across multiple settlements will help reduce the impact of environmental variables on the results of the experiments, and because pantropy adapts the citizens to the general environment, it can be adapted based on discoveries about which genes best help people thrive on Ganymede.

Also, pantropy allows citizens to be more comfortable in their environments and potentially live longer, and their health will be less fragile. This means that the environments across settlements could be beautiful and varied, not just efficient. Because more than a third of people with a chronic disability also face mental illness related to their physical illness, addressing and reducing the incidence of physical health problems on Ganymede will naturally lend itself to a society that faces less mental health problems. This will make Ganymede more empathetic and creative, because they will be happier and have the mental capacity to think about things other than being sick.

As people become healthier and better adapted physically, they will be able to shape Ganymede to be more collaborative, equitable, and beautiful, because they won't just have to consider it like an incubator for fragile human life. Instead, they can shape it to be what they WANT it to be, instead of just what they NEED it to be.

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