Supercomputing Challenge 2016-2017
Interim Summary

Team #1 – Team Heart - 6th Grade

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Team Members

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Background

Worldwide, 558 people have been classified as ‘astronauts,’ traveling in space. This is through *all* of human history. 134.7 man-years have been spent in space by humans, in total, as of December 7th, 2016, according to Astronaut/Cosmonaut Statistics.

Astronauts are brilliant. Most have Ph.D.’s and, or multiple degrees. They are able to conduct complex maneuvers and experiments. Astronauts are the best of the best. Nothing is left to chance.

Astronauts are also meticulous learners. For instance, they do advanced training at Johnson Space Training for 2 years. Then, astronauts go to the ISS program. Finally, the astronauts complete a one year training at NASA. Along the way they spend time doing vestibular visual protocols, a workshop. Russian language classes are taken so that they are effective in communicating with Russian counterparts and experts.

So, astronauts do the right things, at the right times, and for the right reasons, both physically and mentally. However, despite the fact that astronauts exercise religiously, long-term periods in space, experiencing microgravity, creates short and long term health problems for them. The effects of microgravity include, but are not limited to decreased in muscle mass, heart mass (atrophy), bone mass, blood pressure and compression by ribs of the lungs. Additionally, vertebral (spinal) discs increase in height and astronaut's eyes change shape 25% of the time.

There are 17.5 million people alive today. 7.4 million die of them die of heart disease per year. So, the ability to help people with heart disease, in addition to people who travel in space, makes this research more valuable.

Statement of Problem

Long term living in microgravity leads to astronauts' hearts (cardio) becoming more spherical (rounded). Additionally their hearts atrophy (weaken and waste). For people on Earth and for those in space, we need to maintain and, or improve heart strength and function.

Description of Research

We have reviewed information online and scientific papers about:

1. astronaut training and education
2. astronaut exercise requirements
3. the effects of prolonged bed rest
4. statistics on the number of astronauts and general human population on the Earth
5. gravity versus microgravity
6. hyperbaric chamber function
7. military applications and protocols of hyperbaric chambers
8. basic cardiac, vascular, conditioning, deconditioning information
9. plasma donation

10. APA citation

Description of Method

We first had to state our problem, then do research on the internet to search out scientific articles, such as from NASA and cardiology. Then, we had to get permission to upload NetLogo from our school district. We are now spending time researching more plus experimenting with programming in NetLogo 5.3.1.

At first, we wanted to have our computer model:

1. A functioning heart model of a “normal” person on Earth
2. A functioning heart model of an astronaut that has suffered from atrophy (weakening), due to being in space for a long time. Or for a person on bed rest.

We also want to give the agents (astronauts) objects, but need very specific data on/about incorporating:

1. time in oxygen-rich environments such as in a hyperbaric chamber
2. oxygen rich environments that astronauts breath all the time by changing the percent of different elements in of the air
3. keep up or improve exercises the astronauts do every day
4. restore the effects of gravity, by providing more gravity than microgravity, for a certain amount of time
5. provide plasma transfusions (from young donors)
6. provide nutrition to help keep astronauts as strong as possible
7. increase plant life in the space module to naturally produce oxygen through photosynthesis and ‘scrub’ carbon dioxide that astronauts produce through respiration (breathing)
8. combine hyperbaric chamber, gravity and treadmill or exercise into one activity
9. sleep for astronauts with enriched (one or two objects) environments to make the most of their sleep time

We will have to see what specific numbers and data that we have from reviewing the NASA experiments and scientific papers we just had emailed to us. This will help us decide how many of the objects we can add as objects for our astronaut agent model.

Validating the Model

We are not to the validation process yet. However, we will run multiple "ticks" (repetitions within a programmed code's cycle) to validate. Additionally, we would like an expert opinion on appropriate algorithms to check the validity of our agent and objects model.

Temporary Barriers

1. Time to devote to learning coding
2. Speed of learning coding
3. Lack of present knowledge of interface commands (the NetLogo 5.3.1 has code that we can learn from, but the interface commands are not included)
4. Recent access of multiple NASA experiments and research papers that we must review that address specific health and other parameters. These documents will give us what we need to define specific numbers needed for objects in our agent-based model (atmospheric composition, time spent exercising daily in space, etc.)
5. More research, synthesis of information
6. More coding, conducting and refining multiple trials with agent-based computational models.

Results

Results are unknown at this time. They are to be determined by the results of our agent model. We hope to model success in keeping astronaut hearts strong.

Overview

Pending 2017.

Subcategory A

Subcategory B

Subcategory C

Subcategory Additionals (D, E, etc.)

Conclusions/Goals

Currently, we are unable to know the conclusion. We are due in the middle of creating the agent based computer models. However, what we hope to find as a conclusion and our goals is to prevent cardiorespiratory, vascular and muscular deconditioning. This should also result in the prevention of overall physical wasting and atrophy, bone mass loss, and other negative effects of space and microgravity on astronauts. This will also benefit heart patients and others here on Earth.

Significant Achievements

We have been meeting frequently and routinely as a team. This makes our project stronger and equalizes the work between our team members. We have learned more about each other's strengths and what we can all add to the project. We have a "person" agent that is moving through the patch and have been able to randomize movement, have been able to program various agents physical characteristics, add buttons to auto run, reset the program we are running. We have also been able to upload coding from the NetLogo 5.3.1 manual to take a historical look at some basic game programs and be able to compare play, including lag times and how simple the games used to be. These have been fun and challenging.

We have also contacted NASA and received information from them, as mentioned.

Finally, we have contacted a local cardiologist, who may agree to work with us on our project, come and be a guest speaker.

Acknowledgements

Ms. Tamara Gabrel, our advisor, 6th grade ELA teacher, and gifted teacher, at Mesa View Middle School, who helps us with medical information and community outreach.

Mr. Terrill Henegar, our computer teacher, at Mesa View Middle School, who has agreed to be available to answer programming questions in the future, as a consultant.

Mr. Jim Johnson, Jr., IT consultant, who has volunteered to assist with NetLogo coding and interfacing when we come to barriers that are not easy.

Ms. Diedre Thomas, NASA's Life Sciences Data Archive, Human Health and Performance Contract. Thank you for providing additional information and links to research and experiments involving NASA astronauts.

Thank you to all of our NASA astronauts from the past, present and future who have given or will give their all for their country. We are grateful to both you and your families.

Screenshots

Available upon request, we have several in our documentation.

Code

We initially tried Blender, but shapes are not easily made and less interactive than we wanted. Animation was much harder than we thought it would be in Blender. NetLogo 5.3.1 actually is working the

best as our agent-based model.

We are still in the process of experimenting with code and referring to NetLogo 5.3.1 Manual. We have no specific programming that we are doing beyond what we mentioned in significant achievements, so far.

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