Rationale and Guidelines for the 2022 Student Diet Contest

Prepare for an Analog Mars Mission with a Diet Designed by the Contestants to Reduce Markers of Metabolic Syndrome and Extend Healthy Lifespan

Introduction

The winning 2022 contestants will present a reasonable and sufficiently detailed plan to conduct it prior to and during their analog Mars missions on Earth conducted by Mars-Moon Astronautics Academy and Research Science (MMAARS, Inc.), based on their plans developed in response to the 2022 Contest theme of "Blueprint a Healthy Lifespan for Earth and Mars." Their food, nutrition, and diets will be responsive to the goals of the contest set forth in the 2022 contest design shown on the SpacEdge Academy website. The future contest concept of developing food technologies will move forward when we have settled on a food and nutrition design approach, individually tuned, that meet the NASA goal of reducing likelihood of an adverse reaction to space radiation, principally galactic cosmic radiation (GCR).

The 2022 Contest winners will extend the 2021 winning entries by
1) Again prepare themselves with trial diets of their design to accomplish a baseline good state of health;
2) Offer a rationale for why the measures they propose will also prime the potential for extending healthy lifespan.

We ask the contestants to measure the markers of metabolic syndrome, also known as insulin resistance, after a trial period with their diets.

Multiple experiments and investigations conducted by NASA's Nutritional Countermeasures (NCM) Branch at Johnson Space Flight Center have exposed major issues regarding the current health of ISS astronaut crews. Information from dietary and metabolic studies among astronauts reporting insulin resistance are regarded as an important factor in the occurrence of Spaceflight Associated Neuro-ocular Syndrome (SANS). More recently, NASA has identified tissue mitochondrial dysfunction, resulting in insulin resistance as the 'hub" of space flight injury studies. These reports warrant evaluations of crew dietary outcomes to updste NASA's dietary and nutritional specifications for spaceflight and preparation for spaceflight. NASA still quotes the current dietary guidelines for astronauts based on the 1980 USDA dietary options adopted for the Space Shuttle program. These guidelines stress high carbohydrate content of 50-55% and minimal dietary fats and proteins, but some 2700 calories of intake daily from these sources.

Insulin resistance in most cases begin prior to space flight. Insulin resistance is also a major pre-disposing condition for many modern diseases including susceptibility to the covid-19 pandemic. An excellent review of the clinical research regarding metabolic syndrome, its consequences and dietary countermeasures is given in this YouTube video by Dr. Paul Mason, a sports physiologist and general practitioner in Sydney, Australia: https://youtu.be/LRHir1k9jmE and elsewhere here on the Contest website.

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Recent studies by Dr. Jason Fung of Toronto, and others, suggest that fasting, or "time-restricted feeding," may also be important for deep space missions. For mild conditions or maintenance, there seems promise based on studies of intermittent fasting, e.g. about 16-18 hours per 24-hour day. Extended fasting has shown promise for more advanced conditions such as type 2 diabetes. Although largely based on case report studies and anecdotal reports, there seems support for a combination of low carbohydrate, high fat, and moderate protein diets (also known as mildly "ketogenic" diets) or variants of the Mediterranean or South Beach or Paleo diets. The addition of time restricted feeding seems to reduce metabolic syndrome disorders by enhancing natural recovery systems at the cellular level. . . Improved metabolism seems likely to promote resistance to many chronic diseases, as well as to chemical, radiation, and other stressors present both in space and on Earth. Dietary and behavioral recommendations that "improve health enough to survive on Mars, can improve health for those who stay on earth." This is the theme of this series of Contests.

The Challenge: Given specific initial biometric and metabolic measures that are correlated with metabolic syndrome, make a plan to maintain or restore metabolic health and explain why maintaining metabolic health will be crucial to healthy lifespan extension.

The 2022 Contest is:

Title: **"Blueprint a Healthy Lifespan for Earth and Mars"**

Subtitle: **"A Food, Nutrition and Fasting Plan for Space flight to Mars to Extend Healthy Lifespan for Earth and Mars."**

The following elements should be included in the design study:

- A 30-day study any time prior to a Mars analog mission using the proposed diet plan to demonstrate maintenance of or restoration of metabolic health.
- The markers of metabolic health we indicate to use for Initial and final measures of metabolic health/ metabolic syndrome and an explanation of how the indicated markers should be effective in determining the effectiveness of the contestant's diet plan in addressing consistent the goals of the Contest.
- A food diary with labels of food, source, and quantity by volume or weight, and time intervals of fasting and feeding
- Intermittent fasting and/or time restricted eating and the contestant's rationale for using the selected type and interval of fasting (e.g., 12-18 hour daily fasting and periodic longer fasts)
- Consideration of other complementary interventions such as exercise, meditation, socialization, and an appropriate Controlled Ecological Life Support Systems (CELSS/ECLSS)

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Eligibility:

Graduate students, undergraduate students, and citizen-scientists interested in diet and optimal health.

In addition to the food and nutrition plan, the contestant should seek evaluation for one or more metabolic syndrome markers including insulin resistance (HOMA-IR=(fasting blood glucose x fasting blood insulin)/402); a value less than 1.5 is considered healthy), fasting glucose levels, blood pressure, blood serum triglycerides, HDL (and central adiposity (waist measurement/height; a value of 0.53 or less is considered healthy). These are the full panel of indicators we recommend to be used. However, two of them can be self-performed: blood pressure and central adiposity. You may also obtain access to a blood glucose monitor if you can get a prescription. One of the Contest managers found that Medicare/Humana paid for the blood tests in his annual physical exam, though they are not routinely requested by doctors or patients. The doctor coded these tests as "wellness tests," which may explain why they were not charged to the patient.

There will be a broader panel of no-charge tests conducted by MMAARS attending physicians at the beginning and end of the study to evaluate the presence and progression or remission of conditions other than metabolic syndrome. The winning contestant(s) may then be invited to evaluate the improvement of these markers over the short duration of their analog mission as well as in mission follow-up.

Goals:

1. Design a dietary plan (food, nutrition, fasting) that promise to improve the health of analog mission participants and possibly extend healthy lifespan.
2. Get evaluated at the beginning and end of the analog mission for improvement in the markers of metabolic health.
3. Provide a discussion of how the same plan may contribute to extending lifespan and briefly suggest other measures beyond the scope of the current contest.

The Task

All contestants:

Submit a white paper with a 30-day food, nutrition and fasting plan to show good metabolic health or reduce or eliminate the markers of metabolic syndrome. Refer to the **Design and Development Guidelines** below and **Challenge design elements** above to perform an "n=1" diet study. Describe the plan including all measurements in the Methods section of the paper.

Winning contestants:

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Will be awarded participation in an analog mission subject to meeting MMAARS medical standards. Winners will be afforded the opportunity to demonstrate their metabolic health based on the markers given below, or may choose to implement their full plan and agree to provide their metabolic data to the MMAARS medical staff. The clinical and research community results and experience tend to show that up to 90 days may be required to reduce or eliminate insulin resistance, the primary marker of metabolic syndrome. Therefore, winning contestants are invited to evaluate their 30-day plan as the first part of a 90-day study, the fiull length of which is not expected for the Contest. The objective is to demonstrate improvement of the markers to reduce or eliminate insulin resistance and metabolic syndrome prior to commencing the analog mission.

Winning contestants should also allow for known food intolerances and allergies and account for them. They also must list medical prescriptions needed throughout the study and analog mission period. The results of the medical examination will indicate the contestant's eligibility to participate in the mission.

Design and Development Guidelines for a responsive white paper entry:

Your subject and title: "**Blueprint a Healthy Lifespan for Earth and Mars"** and sub-title: **"A Food, Nutrition and Fasting Plan for Space flight to Mars to Extend Healthy Lifespan for Earth and Mars**

All winning contestants (after passing medical exam**)**:

- The winning contestant will verify their metabolic health prior to the analog mission awarded, a food and fasting diary should be kept throughout the study period prior to the analog mission.

- To complete eligibility for the analog mission, submit your markers of metabolic health, including two or more as follows:
- Blood serum triglycerides
- Blood pressure
- High density lipoprotein
- Central adiposity
- Fasting blood glucose
- Fasting insulin and HOMA-IR (calculated)

- Address the dietary components listed below and how these components address the pre-existing metabolic disorder, if any, or maintain good metabolic health. List each component both by percentage of total and caloric content (proteins, fats, carbohydrates). See the Table below.
- Specify the sources (processed and/or fresh, grown on-board) of the food.

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- Specify types of fats and proteins such as insects and synthetic proteins as well as 3D printed foods (from stem cells), plant extracts, and perhaps 3D printed plant extracts.
- Include estimates regarding shelf life, packaging, sterilization, aesthetics: appearance, taste, smell, texture, etc.
- Provide a detailed food, nutrition and fasting plan for the 3-month duration of the study

Table 1. Nutrient description and ranges (low% -high%)

- Percentage of proteins (all kinds)
- Percentage of Fats (all kinds)
- Percentage of Carbohydrates (all kinds)
- Dietary Fiber (indigestible carbohydrates)
    - Soluble
    - Insoluble
- Carbohydrates classified by Glycemic Index (GI)
    - High GI: 70 and higher: sugars, starches
    - Medium GI: 56 to 69: potatoes, corn, white rice
    - Low GI (1 to 55): fruits, vegetables, nuts, beans, resistant starches
    - Glycemic load (GL)
- Micronutrients and supplementation
    - Vitamins
    - Minerals
    - Probiotics and prebiotics
- Food intake intervals
    - Intermittent fasting
    - Alternate day fasting
    - Prolonged fasting

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White Paper Content

Use the following questions as guidelines for the Background section of your paper:

- How would you describe the basic benefits claimed for your food, nutrition, and fasting plan, and why?
- Does the genetic/mitochondrial damage from common exposures on earth (e.g., seed oils, fructose, sucrose, pesticides, dissolved metals, food toxins) affect your metabolic health and ability to respond to your food, nutrition, and fasting plan?
- Would you expect the genetic/mitochondrial damage due to space ionizing radiation to add to pre-existing genetic/mitochondrial damage?
- Would you expect the genetic/mitochondrial damage from space ionizing radiation to be reduced or eliminated by your plan?
- If you elected the metabolic study as part of your food, nutrition, and fasting plan, would you recommend the plan also for the analog mission and why?

White Paper Length, Formatting and Style Requirements

The white paper will be generated in Microsoft Word or equivalent and submitted electronically in pdf format, properly formatted as if it were a text document and following the guidelines below.

All papers must be typewritten, double-spaced on one side only of 8 ½" x 11" paper, with 1" margins on all sides. Use 12-point Times New Roman font.

1. Paper is limited to 15 pages. This does not include the title, table of contents, abstract, appendices or references pages. Appendices are limited to 5 pages maximum.
2. Do not place names of people involved in the creation of the paper or the school(s) involved in the paper.
3. The pages of the paper must be numbered consecutively beginning with the Introduction. Diagrams and tables may be included either within the paper or as part of the Appendices.
4. In general, the contents of the paper shall be organized as follows:
    a. Title page: Only include the title. The title should consist of the minimum number of keywords necessary to portray accurately the contents of the paper. Reader interest is stimulated by a well-chosen title. The author's name must **NOT** appear on the title page, nor should any other persons or schools.

b. Table of Contents: The table of contents should consist of a list of the parts of the paper and the page numbers, in order in which they occur.

c. Abstract: The abstract should not describe the paper, but should give, in brief, the essential facts of its contents; for example, a brief of the problem or objective and a concise summary of the results or conclusion, touching upon methods or other details only if they are unique or if they are of some particular significance. The abstract should be no longer than 100 words.

d. Introduction: The introductions should lead to the development of the subject so that the reader may obtain a clear understanding of the significance of the content, data presented, and/or conclusion. This can often be done by briefly giving the state of the art as background and then by bringing out the added advantages of the method of approach and emphasizing the importance of the results or conclusions.

e. Body: The main argument of the subject is carried out in the body or its subsections, complete with supporting data. The argument should proceed in a logical sequence according to a prepared outline. The writing should be in the third person. Support data and results can be presented most effectively as graphs, charts, or tables.

    i. Standard graphical symbols and abbreviations should be used on all drawings. Well- known abbreviations may be used in the text but should be defined where used the first time followed by the abbreviation in parentheses. Generally, the use of abbreviations should be confined to tables and illustrations.

    ii. Illustrations and tables should supplement, not duplicate, text materials. Likewise, they should complement, not duplicate, each other.

f. Conclusion: The conclusions are often considered the most important part of a paper. They should be stated concisely in a separate section at the end of the paper. If there are three or more conclusions, better emphasis can be obtained by numbering or labeling each conclusion and setting it off in a separate paragraph.

g. Tables: Generally, each table should be typed on a separate sheet in an appendix and numbered consecutively using Roman numerals: Table I, Table II. However, they can be inserted as part of the 15 pages. Small tabulations or listings may be made in the text where necessary for continuity. Each table should be titled by giving the brief description as a heading following the table number at the top. Ditto marks should not be used in tabled data, but brackets may be used to group information on several lines.

h. Figures: Figures should be numbered consecutively using Arabic numerals: Figure 1; Figure 2, etc. Three types of figures may be used: photographs, biochemical pathways, and line drawings. The reading material on illustrations should be kept to a minimum. In short, the reading material should be included in the captions. Portions of the illustrations may be identified by letters and explained in the captions. Whenever feasible in graphs, several trend lines or regression curves should be combined on the same coordinates. Their identifying letters or numbers should be in clear spaces between cross section lines. Readers generally prefer having the figures distributed through the paper, although it is also permissible to bind them together at the end in an appendix.

i. Appendices: There may be no more than 5 pages of appendices. Detailed biochemical pathways, development of nutrition sub-components in tables and examples, which are subordinate to the main argument in the body of the paper, and not essential to following the argument, should be treated in the appendices. Main graphs as they are developed should be numbered consecutively. The graphs, figures, and tables in the Appendices should be numbered consecutively, following the numbers used for the graphs, figures, and tables in the text (such as, if table IV were last in the text, table V would be first in the Appendices.)

j. References: To enable the reader to consult important works used by the author incidental to the preparation of the paper and other related literature that might be helpful, a suitable reference list should be appended. References should be numbered consecutively and should follow MLA formats. Examples are shown below:

For a periodical: R.N. Hall, "Power Rectifiers and transformers," Proc. IRE, Vol.

40, pp. 1515-1518, November 1952.

For a book: W.A. Edison, "Vacuum Tube Oscillators," John Wiley and Sons,

Inc., New York, New York, pp. 170-171, 1948.

For an article: B. Lawrence, B.H. Weil, and M.H. Graham, "Making online

search available in a industrial research environment," Journal of

the American Society for Information Science, pp. 364-369, Nov- Dec. 1974.

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For an online reference:

Jason Fung, Published on 3/5/17, YouTube Video “Jason Fung: “The Complete Guide to Fasting (& how to burn fat)”. https://youtu.be/n3dwizlGaRI.