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Decadal Survey on Biological and Physical Sciences Research in Space 2023-2032

Author:

Daniel Lappin, BA

Interogenesis Designs

Daniel@daniellappin.com

415-936-9981

File name: LappinDanielJ.doc

Topical: A Systemic Solution: Translating Origin of Life Protocell Mechanisms into a Novel Research Method for Microgravity, Space Science, Technology, & Earth

Abstract

Origin of Life protocell structures and mechanisms, identified and organized by a transdisciplinary study, reveal a basic science gap, and proposes a new paradigm for a potentially novel fundamental biological mechanism of action and process, and anatomy and physiology model. A novel method is proposed to systemically improve efficiency in science research and technology development, in general, and specifically in microgravity. These conclusions are derived from a case study of an anomalous medical patient whose self-diagnosis (biological discovery) and recovery reflect the protocell.

Introduction

Selected structures and mechanisms of the protocell, identified and organized by a transdisciplinary study, and driven by an anomalous medical patient case study, can be translated into a novel curriculum and method to improve efficiency and reduce risk in science research and technology development. These appear to constitute a novel approach, a new paradigm, to enable scientific discovery as well as how scientific research is conducted, especially regarding microgravity. The initial assessment proposes that a systemic productivity gain will be achieved by implementing the suggestions of this project. These proposed innovation can translate basic science to the social economy.

Science Innovation from an Anomalous Medical Patient Case Study

The perspective of this paper are from an out-side-the-box source, and has the markings of a novel approach that reveals a new paradigm. The assertions in this initiative are derived from an N=1 case study of an anomalous medical patient with a complex, unknown, intermittently disabling medical condition. The patient innovated under extreme conditions and self-discovered a fundamental biological mechanism of action and process, and then utilized them for self-diagnosis (discovery) and recovery from the life altering symptoms. After decades of medical evaluation, the patient has been diagnosed with Mast Cell Activation Disorder, Toxic Metabolic Encephalopathy, Hypoxic Ischemic Encephalopathy, bacterial and viral infections, genetic polymorphisms, and potentially, a rare disease, yet this last diagnosis is awaiting conclusive lab tests.

Seeking medical solutions and understanding for their condition, the patient pursued a notable qualitative transdisciplinary study centered around principles of anatomy & physiology (A&P), including study of existing research on the developmental stages of the protocell in origin of life research. They concluded that the biological mechanism of action and process that they self-discovered and utilized are seen in the protocell, and its developmental stages, yet do not exist as clearly defined or well organized principles within the basic sciences, across academic disciplines, in western science and medicine, western psychology, within Integrative Health, or within global arts and humanities. They only exist as fragmented pieces and principles across these domains.

This initiative proposes to translate these insights into 1) An inquiry and discovery curriculum and method to increase productivity in science research, specifically in microgravity research. 2) A method to enhance technology development.

A Concept Gap in Basic Science?

The transdisciplinary study concluded that a concept gap, a missing concept, exists at the intersection of biological and physical basic sciences. It is proposed that this concept gap helps to explain why the biological mechanism of action and process discovered and utilized by the patient of the case study are not clearly labeled, organized or widely utilized across science.

The proposed concept gap centers around the issues of: 1) 'Simple machines', 'work' and 'work efficiency', 'force', and 'tool building'. 2) 'Work', 'force', 'measurement', 'communication' and 'relationship' principles within biological versus physical sciences. 3) A&P principles and

models that incorporate these principles. It is asserted that: A) Several factors of productivity and efficiency are intertwined within the concept gap. B) This concept gap has existed historically in the culture of academia and science. C) It influences how researchers explore the biological and physical world, develop machines and technology, and relate to biology. D) Contributes to inefficiency, missed productivity, and increased risk within science research.

Potentially, the repair of this concept gap is a refinement, and potentially a novel advancement, in the understanding of fundamental biology. This initiative proposes to repair this basic science oversight by: 1) Defining a new term to describe and organize the mechanism of action and process. 2) Proposing a refined model of Anatomy and Physiology to incorporate the proposed principles. 3) Presenting a productivity and risk reduction methodology to support research and development in biological and physical sciences, and for technology.

Opportunity to Increase Efficiency and Productivity in the Culture of Science

It is asserted that the repair of the concept gap offers clarity to the prevailing culture of science, its inquiry, discovery, measurement, communication and relationship methods, and its human anatomical and physiological world view. Potentially, and most notably in biological research. It is proposed that this cultural pattern hypothetically is more costly, impairs outcomes, is more risky, and misses opportunities. The repair of the concept gap presents a new paradigm.

For example, hypothetically, the science concept gap relates to a brain/endocrine/physiology region that influences the cultural of science. This region has two branches. One branch is favored within science, in part because it is more easily measured. The other branch is undervalued, in part because it is more difficult to measure and is has complicated consequences. This apparent favored pattern creates an imbalanced, distorted world view of biology and the physical world. The favored pattern is out of synch with the structure and mechanisms of the protocell. The expression of these two brain/endocrine/physiology regions appear to be influenced by the historic trends, in legal, economic, educational, and medical philosophies and practices each contributing to a world view of the human body.

Improving Research Productivity with Curriculum, Method, Anatomy & Physiology

The proposition of an opportunity to enhance the culture of sciences poses the questions: How do science researchers ask research questions in general, and specifically about systems biology, microgravity, microbiology, biophysics, viruses, climate and the environment?

This paper's perspective makes the distinction regarding the process of inquiry: between research questions that are asked cognitively, versus, questions that are asked by engaging by both cognition and physiology. Specifically, how the researcher engages their cognition and physiology during inquiry and investigation. It is proposed that this cognitive plus physiology approach more clearly reflects actual biology including the protocell model, and has special application to research in microbiology, systems biology, biophysics, and microgravity.

A curricular and methodological solution set have been designed as an educational training tool to help achieve the benefits of the novel cognitive and physiology approach. The solution set incorporates: 1) The repaired concept gap; selected elements from the protocell and its

developmental stages. 2) The biological mechanism of action and process in the patient case study. 3) The A&P principles from the transdisciplinary study. These elements are organized into a set of principles, and a visual representation of anatomy and physiology (A&P). The visual representation enhances the common medical image of the human body in anatomical position with directional coordinate planes.

It is proposed that the curriculum, method, and skills achieve systemic efficiency and productivity in science research, including: 1) Improved inquiry, discovery, perception, measurement, communication, imagination, creativity, expression, integration, system thinking, innovation, and organization. 2) Support collaboration between cross-disciplinary teams by sharing a common inquiry method to support communication, relationships, project design, synchronicity and integration. 3) Improved understanding and organization of complex systems, and systems biology. 4) Projects with notable unknown factors. 5) Specific benefit to research in microbiology, microbes, viruses, bacteria, and systems biology in space microgravity and on earth.

The implementation of this curriculum and method will easily integrate with existing research principles and processes. The approach does not replace existing research practices, but instead, is additive, complementary and integrative. It is a simple, practical, high value approach, not a difficult mental abstraction. The approach utilizes an apparently novel principle of procedural memory, at the level of microbiology. Thereby, the approach may be more easily assimilated and utilized by early career scientists to support them to be less encumbered by prevailing cultural patterns of thinking and routine, to thereby access a more full and real perception of biology, and potentially to generate fresh insights. The approach is low tech, low cost, low risk, and potentially a high return on investment. It appears to be low hanging fruit.

The assertions in this paper propose a world view of biology and human anatomy and physiology (A&P) that some people may find complementary and integrative with existing perspectives, whereas, others may find the perspective to be a radical, disruptive, out-side-the-box, world view, fitting the definition of Transformative Research by the National Science Foundation, see:

https://www.nsf.gov/about/transformative_research/definition.jsp

Research Questions

1. Is there a concept gap in basic sciences between biological and physical sciences? Does this gap create a cultural pattern in science research and thinking toward metaphors of machine 'work', communication and measurement, versus biological 'work', measurement, communication and relationship? Does this influence the methods utilized by research scientists and thereby effect their efficiency and outcomes? Can part of this cultural pattern be described as an expression of a brain/endocrine/ physiology region?
2. Does the physiology of a research inquiry matter? Is there a distinction between cognitive inquiry and physiology based inquiry? How well do each reflect actual biology, such as seen in the protocell?
3. Can clues in the protocell support tool, machine and technology development? Do some structures and mechanisms of the protocell reveal a poorly identified and under-investigated mechanism and biological process, in a hypothetical evolutionary progression organized around principles of 'work' and 'work output', from: 1) The Origin of Life protocell. 2)

Brain development and tool-making in the human hominin biped. 3) The evolution of simple and complex machines. 4) Historic artistic expressions of the human body. 5) Medical science diagrams of human anatomy and physiology (A&P) since the 15th century. 6) The emergence of complex tools, machines, technology and scientific advances since the 19th century.

4. Can a novel, modified principle of procedural memory scale and integrate across microbiology to sensory motor to cognition? Can this principle support researchers to study microgravity and its effects? And, support inquiry into artificial gravity?

Scope of Applications: Systemic Solution; NASA, SMD, HRP, Earth

In the announcement by the National Academies of the Decadal Survey on Biological and Physical Sciences Research in Space 2023-2032, the statement of 'Scope' reads:

... the committee will not review the discipline areas of NASA's program of risk identification and mitigation for astronauts except to the extent that biological research in microbiology, animal biology or plant biology could inform that program. Translational research, innovative methods and procedures, and pre-clinical studies (particularly those involving understanding biological processes, normal or pathophysiological adaptation to microgravity, and mechanisms of action) may be included.

This paper asserts that: 1) Repair of the concept gap in basic sciences. 2) The identified biological mechanism of action and process reflected in the protocell. And 3) The proposed curriculum and method to conduct research and to improve research, especially in biology, microbiology, microbes, viruses, bacteria, and systems biology, and in microgravity - fit within the decadal scope of 'innovative methods', 'understanding biological processes', and 'mechanisms of action' that can inform NASA's program of risk identification and mitigation for astronauts.

This assertion echoes the following statement by the Science Mission Directorate website:

The Science Mission Directorate (SMD) is an organization where discoveries in one scientific discipline have a direct route to other areas of study. This flow is something extremely valuable and is rare in the scientific world.

The assertions and proposed benefits contained in this white paper support this SMD statement, and apply the novel innovations within this paper to address and go beyond the Decadal Survey on Biological and Physical Sciences Research in Space 2023-2032 to a 'Whole of NASA' systemic solution, specifically for the Human Research Program, and as well, to notable applications for productivity gains on earth.

These extended applications and benefits are worthy of noting and investigating. The study proposes parallels between: 1) The case study patient's medical condition and symptoms, their innovative self-diagnosis and recovery method in the face of an unknown, complex medical condition. 2) Research methods in science, specifically biology. 3) Astronaut health countermeasures, and physical and cognitive performance. 4) Opportunities on earth in education, healthcare, business productivity and innovation.

Request to Reviewer: Given the extreme nature of the patient case study, it is requested that the decadal reviewers of this white paper please forward it to the Standing Committee on Aerospace Medicine and the Medicine of Extreme Environments within the National Academies for further review for its potential application and benefit to the Whole of NASA, and to the Human Research Program.

Potential Application for NASA Human Research Program

The proposed curriculum and method of this project have additional benefits to a broad range of human capacities relating to health countermeasures, and cognitive and physical performance:

1. Multiple sections of NASA's Human Research Roadmap, and specifically, the CBS Integrated Research Plan (Central Nervous System, Behavioral Medicine, Sensory Motor).
2. An underdeveloped systems biology element of fitness and performance that, hypothetically, offers a new astronaut countermeasure to microgravity, radiation and isolation decrements.
3. Autonomous Medical Care: a method for a self-generated diagnostic method that can work in conjunction with clinical diagnostic technology, remote sensing and AI driven diagnostics.
4. Skills based countermeasure for immune, inflammation, lymphatic, infectious disease and virus issues relevant to Astronaut health.

Human Health and Performance on Earth

This paper asserts that the basic science concept gap mentioned above, present historically, presently cascades into inefficiency in the education and health sectors, and into business and industry performance in general.

The proposed curriculum and methodology solution fills a critical gap in Western Medical practice (based upon the patient case study) and can be a novel prevention tactic and countermeasure applied across the health continuum from pre-natal, family and pediatric health, to adult illness, to elder and hospice care. Existing research, establishes that principles related to the proposed curriculum and method contribute to a large portion of national healthcare costs and mortality, ranging from obesity, cardio-vascular disease and strokes, immune and inflammatory conditions, stress and illness, and mental illness. Furthermore, the proposed curriculum and methodology, due to its foundation in the protocell, presents approaches to support research in immunology, inflammation, lymphatic, infectious disease and virus issues. This is a high value application for global health and infectious disease related to the pandemic, and as well, some health impacts from climate change. Combined these factors constitute a notable macroeconomic opportunity.

Project Valuation

This paper proposes a focused project to develop these opportunities and achieve the research and productivity gains asserted in this paper. This appears to be a non-obvious, low hanging fruit opportunity – a soft skill with a potential large impact.

Multiple factors support the claim of a systemic productivity gain and risk reduction from implementing these solutions, including: 1) The fresh insights of the study. 2) The historic impact of the basic science concept 'gap' and its effect upon the proposed inefficient culture of science. 3) Effects of this potential cultural pattern in science upon social economic costs, such

as healthcare and education. 4) Affirmative conversations with three Nobel Laurates in Economics, and several healthcare industry executives. 5) Research based valuation of healthcare trends. 6) Costly real world issues, such as the current pandemic, related immunological and virus factors, the rise of immune/inflammation related illness, and escalating climate change related illnesses.

Post script: This paper withholds details of the project that are not ready for public release.
Daniel J. Lappin, Interogenesis Designs, daniel@daniellappin.com, 415-936-9981.
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