

20/20 Virision Meeting Program

“Using the Gaian Virosphere as a supercomputer for the last 3.8 billion years, Deep Thought has calculated that the Answer to the Ultimate Question of Life, the Universe, and Everything will be known by 2042. Our job is to figure out what the question is...” - F.L.R. paraphrasing Douglas Adams

After much zooming using the Improbability Drive, the Ultimate Question of Life, the Universe, and Everything appears to be, "Is it All Microbialization?"

November 19 (Saturday)

3 pm - Facilitators Orientation Meeting at Segall-Rohwer Casa
(4116 Maryland St)

5 pm - Welcome Party at Negociant (1263 University Ave)
- Discussion about Day 1 Questions

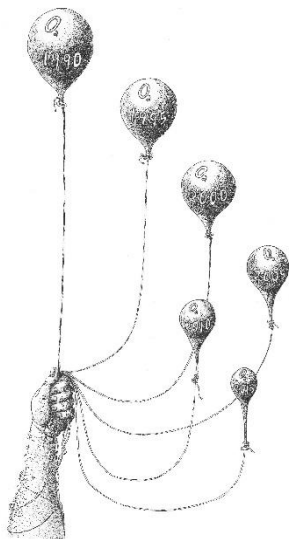


The main meeting site will be Bread & Salt at 1955 Julian Ave

November 20 (Sunday)

8:30 am - Awakening at Bread & Salt
> coffee, other drinks, & light fare

9 am to noon - Brainstorming in Working Groups (see Meeting Mechanics section below)



Is it All Microbialization? Microbialization occurs when natural and anthropogenic processes favor energy use by heterotrophic microbes. The ultimate cause is the Goldilocks Line, which delimits energy landscapes into free energy generated from excess electron acceptors (e.g., oxygen, ATP) versus excess electron donors (e.g., organic carbon, biomass). Viruses tend to be lytic with more ATP and temperate when cellular hosts are building biomass.

Some potential talking points:

- > Increasing temperatures will increase microbial activity & organic carbon release, as CO₂, from the ocean & land.
- > Partial pressure of oxygen in the atmosphere is going down, favoring the microbes.
- > Increasing CO₂ will increase primary production. In turn, this will

lead to priming/co-metabolism of refractory organic carbon which might be offset by production of new, refractory organic carbon.

> Increasing CO₂ lowers the pH of water. In turn, this leads to microbes eating refractory organic carbon, which lowers the pH (think wine or yogurt).

> Permafrost melting will increase microbial mediated organic carbon remineralization, primarily under low oxygen conditions with all the nasty metabolites like methane & fermentation products.

The Wild Cards - How to define the Goldilocks Line? With excess electron donors (e.g., sugar), cells tend to build biomass. Conversely, when there are excess electron acceptors (e.g., oxygen), cells tend to produce ATP. These two strategies are tightly controlled and are a major cue for the viruses (i.e., excess sugar = temperate behavior, excess oxygen = virulent behavior).

keywords/talking points: free energy, labile & refractory organic carbon, virulent, temperate, redox, electron donor to acceptor ratio (e⁻DAR)

The Chaotic Neutrals - Is microbialization an existential threat? Most of the positive feedback associated with microbialization seem bad (i.e., increasing temperature & pathogens, decreasing oxygen & pH). There are, however, always negative feedbacks that regulate the biosphere (e.g., nutrient limitations on primary production). Taken together, will the negative feedbacks save humanity? For those of you who were worried, the phage should be fine even if humans go extinct:)

keywords/talking points: identify major negative feedbacks (e.g., increasing primary production & weathering)

The Rabbithole - Is microbialization the same everywhere? Ultimately, heterotrophic microbes are surrounded by water. Therefore, decreasing oxygen and pH, increasing labile organic carbon, should lead to microbialization in any ecosystem.

keywords/talking points: protists & the rise of opportunistic pathogens on land vs sea, Are soils always microbialized?

Day 1 working groups.

	The Wild Cards	The Chaotic Neutrals	The Rabbithole
Artist	Ben Darby	Leah Pantea	Kim Reasor
Mather	Arlette Baljon	Sergio Lopez	Toni Luque
Metaomicer	Cynthia Silveira	Linda Wegley	Anca Segall
Writer	Nathan Hillstrom	Breeann Kirby	Heather Maughan
	Bjarne Andresen	Barb Bailey	Adrian Cantu
	Liz Dinsdale	Ana Cobian-Guemes	MFM Fairoz
	Rob Edwards	Emma George	Uduak George
	Ben Felts	Victoria Orphan	David Lipson
	Juli Grose	Ty Roach	Shayle Matsuda
	Jon Kaye	Joan Roughgarden	John Mokili
	Patrick Keeling	Boris Sherman	Paul Rainey
	Peter Salamon	Mio Takeuchi	Katrine Whiteson
	Brandie White	Nicole Jacobson	Cristal Zuniga

noon-1 pm - Lunch - O Food Truck

1-2 pm - Lightning Talks

- > everyone needs a 5 min presentation of your research in the Postomics Age
- > white boards only (no PowerPoints)

2-4 pm - Free Time for Scientists (Facilitators have synthesis meeting during this time)

Scientists walk around Barrio Logan with some colleagues and argue about things.

- Chicano Park, Libélula Books & Co., lots of fun shops along Logan Avenue, & the Low Riders should be cruising on Sunday

4-6 pm - Synthesis Meeting

Tacos at !Salud! (2196 Logan Ave)

- Discussions about Day 2 Questions

6-8 pm - More Food & Bar Games

Mujeres Brew House (1983 Julian Ave; next door to Bread & Salt)

Dinner discussion on the ethics, morals, and the humanist POV for the assertion that humanity should focus on minimizing microbialization by 2042. Please capture the discussion on a paper napkin, notepad, *et cetera* & give it to FLR the next day.

November 20 (Monday)

8:30 am - Awakening at Bread & Salt

> coffee, other drinks, & light fare

9 am to noon - Brainstorming in Working Groups (see Meeting Mechanics section below)

Developing a common language for the biological and hard sciences. Most of biological sciences are producing data and analyses that are not compatible with the hard sciences. This has led to a crisis of non-reproducibility, limited predictability, and debates that are mostly about methods and terms (c.f., the bigger picture). To make progress, we need to stop arguing about methods & terminology by coming up with a common language for biology. Ideally, this language would be directly compatible with chemistry & physics. The goal of these questions is to identify units and words that describe the virosphere. These units and words will help drive the development of our Vircode.

The Wild Card -Viral Metrics: If viruses were developing a metric system for their world, what units would they use? The hard sciences are based on units derived from a human POV; a foot for measurement, bushel for wheat, and fortnight to track the moon. These units have been modified and rationalized into the metric system, but there is no *a priori* reason to expect these units to describe viral life.

keywords/talking points: How does the world appear to a virus? life at high Reynold's numbers, dominated by electrostatic interactions (vs gravity), quantum tunneling, breakpoints of scale, statistical mechanics works well (10^8 mols of viruses), no fear of extinction (10^{23} viruses in each population)

The Chaotic Neutrals - How would you describe viruses with base metric units? Biologists group life forms into species. This kind of misses the point of Darwin & Wallace's Doubtful Species and evolutionary theory, which emphasize the continually changing nature of life forms. Also, there is no easily identifiable connection between the code in the DNA & the physical manifestations of that code.

keywords/talking points: viral species, chorography of the physical-chemical world by life, informed pathways, (m), the kilogram (kg), the kelvin (K), the second (s), the ampere (A), the candela (cd), and the mole (mol)), Major Capsid Protein (MCP), Homologous recombination as a way of cleaning up mutations & horizontal gene transfer events

The Rabbithole -Viral Ethology: What types of behaviors would be the same & unique in virosphere vs the macrobial biosphere and how might these behaviors be quantified (i.e., units)? Viruses are the most abundant & biodiverse life forms on the planet, so they must have some tricks that make them unique. However, we tend to study them as if they are either parasites of cells &/or assign them behaviors based on the macroscopic world. Harness your inner Lao Tzu & imagine being a virus. What would your viral self do?



Be a virus, see the world.

keywords/talking points: types of hunting, social interactions, viral lexicon for genetic screens

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	Uduak George	Boris Sherman	Paul Rainey
	Shayle Matsuda	Peter Salamon	Joan Roughgarden
	Ty Roach	Katrine Whiteson	Mio Takeuchi
	Cristal Zuniga	Jason Baer	Hamza Hajama

noon - 1 pm - Mexican Seafood Truck (we will also have some vegetarian options)

1-2 pm - Lighting Talks

> everyone needs a 5 min presentation of your research in the Postomics Age

> white boards only

2-4 pm - Free Time for Scientists (Facilitators have synthesis meeting during this time)

Scientists walk around Balboa Park (Zoo, museums, gardens) or North Park (Verbatim Books, Artelexia, Coin-Op Game Room)

4-6 pm - Synthesis Meeting

619 Spirits in North Park (3015 Lincoln Ave)

- Discussions about Day 3 Questions

6-8 pm - Self-organized dinner in the North Park area.

How do we test whole Earth engineering schemes? Please capture the discussion on a paper napkin, notepad, *et cetera* & give it to FLR the next day.

November 22 (Tuesday)

8:30 am - Awakening at Bread & Salt
> coffee, other drinks, & light fare

9 am to noon - Brainstorming in Working Groups (see Meeting Mechanics section below)

Using the Vircorder to usher in the Postomics Era & save humanity.

Since we all now agree that viruses are both the dominant and most interesting forms of life, we need tools that will rapidly allow us to understand their influence on the rest of the biosphere. Luckily, the GBMF has generously give us a US\$4.2x10³⁰ grant to build a Vircorder; basically, a virocentric, StarTrek Tricorder. Everything will be measured in the units decided upon earlier and the goal will be to keep humanity alive until 4242 CE despite rampant microbialization.



The Wild Cards -What sensors do you add to the Vircorder? We've discussed several options ranging from a full spectral EM scanner to entropometer. Don't forget your units.

keywords/talking points: comparative statics or fluxes, thermodynamics, kinetics, acoustics of microbialization (bubbles), types of sensors

The Chaotic Neutrals: It is 2042 and all the data has been collected. What do you do with it?

Additionally, high-throughput sequencing, metabolomics, and all spectral imaging, means that biologists have detailed biogeochemical data of every ecosystem by 2042. To make sense of this data we need to design the databases and analysis methods.

keywords/talking points: residuals from the Viricorder, stochastic, dimensional reduction

The Rabbithole: The Viricorder has measured everything and the Ultimate Equation has been determined to be P+H+A+G+E+S = 42. How will you use the equation to save humanity from disappearing into a soup of piggybacking viruses?

keywords/talking points: DNA synthesizers for gene drives, phage therapy, 3D structures, knobs to twist?

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	Boris Sherman	Juli Grose	David Lipson
	Mio Takeuchi	John Mokili	Shayle Matsuda
	Katrine Whiteson	Paul Rainey	Joan Roughgarden
	Andres Quinto	Greg Burkeen	Cristal Zuniga

noon to 1 pm - Mexican Seafood Truck (we will also have some vegetarian options)

1-2 pm - *Lighting Talks*

> everyone needs a 5 min presentation of your research in the Postomics Age

> white boards only

2-4 pm - *Free Time for Scientists (Facilitators have synthesis meeting during this time)*

Scientists walk around Little Italy

4-6 pm - *Synthesis Meeting*

Ballast Point (2215 India St)

Should we do something with the 20/20 Virsion products?

Should we plan to have another Postomic workshop?

Should we just have another beer?

6-8 pm - *Self-organized dinner in Little Italy Area.*

November 23 (Wednesday)

10 am - Facilitators Wrap Up Meeting at Segall-Rohwer Casa (4116 Maryland St)

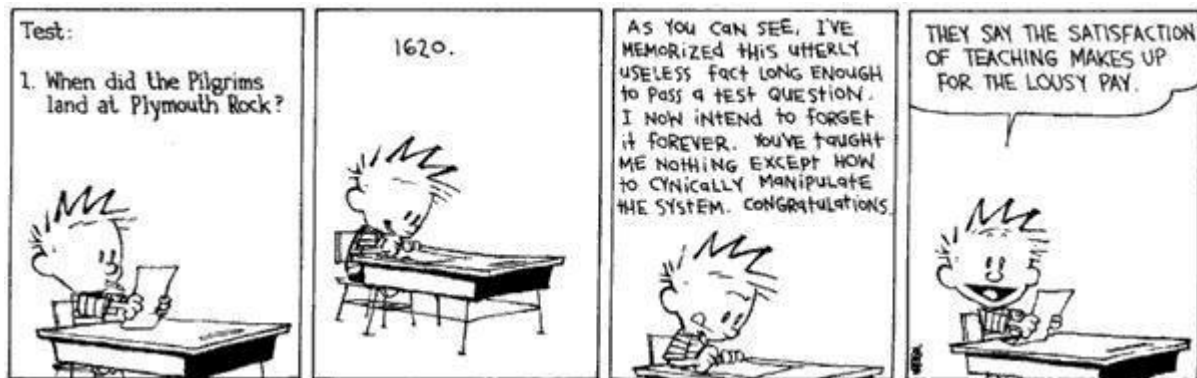
early afternoon - Pub Crawl for anyone that sticks around San Diego.



November 24 (Thursday)

Thanksgiving!

Arlette Baljon has generously invited us to Thanksgiving at her house. Please let me know ASAP if you are joining for the Turkeyfest!



3 pm - for those that want to cook/cut veggies

4 pm - for those that want to go on a hike

5 pm - for those that just want to eat

Meeting Mechanics

The Facilitators

Each of the three Facilitator groups consist of an artist, mather, metaomicer, and writer. The Facilitators are responsible for keeping the working groups on schedule, giving everyone a chance to contribute, and synthesizing the results of each section.

The Scientists

Scientists will be mixed-n-matched through the meeting, so that everyone gets a chance to know and work with each other. The scientists are responsible for: 1) developing an answer for the assigned question and presenting it each morning, and 2) vigorous, vibrant, respectful debate with their colleagues.

8:30 am - Awakening (i.e., caffeine)

9 am - Ranking Session

1) Each scientist will write down their answer to the assigned question and post it on the wall in their working groups area. This could include not liking question and proposing a pivot.

2) Each scientists explains & defends their position for ~2 minute.

> Facilitators can ask clarifying questions

3) Everyone votes by secret ballot passed to the Facilitators.

4) The Facilitators rearrange the Post-It Notes in rank order.

5) At this point, let people who think they are experts for a given topic give a brief overview of the question & their take on ranked answer. The job of everyone else is to question the expert hard.

6) Expose weaknesses and retrench. The Facilitators should especially pay attention to non-experts' questions as this is usually the best ideas are at. It is also very important to get everyone to comment, even if they say, "no comment".

10 am-ish - Start synthesis

10:30 to 11 am - Re-Awakening

> coffee, other drinks, & light fare

> during this time the Facilitators synthesize first discussion w/ text & sketches

11 am to noon - Rotation Session

1) The Scientists rotate to a new Facilitators Group.

2) Facilitators present their synthesis from the previous group.

3) Vote and rank.

4) The scientists give feedback with goal of defending the synthesis product (i.e., modify the synthesis to make it stronger).