



SHYNE
Soft and Hybrid Nanotechnology
Experimental Resource

ILLUMINATE YOUR RESEARCH

Rules of Life (RoL) Research Community (RC)

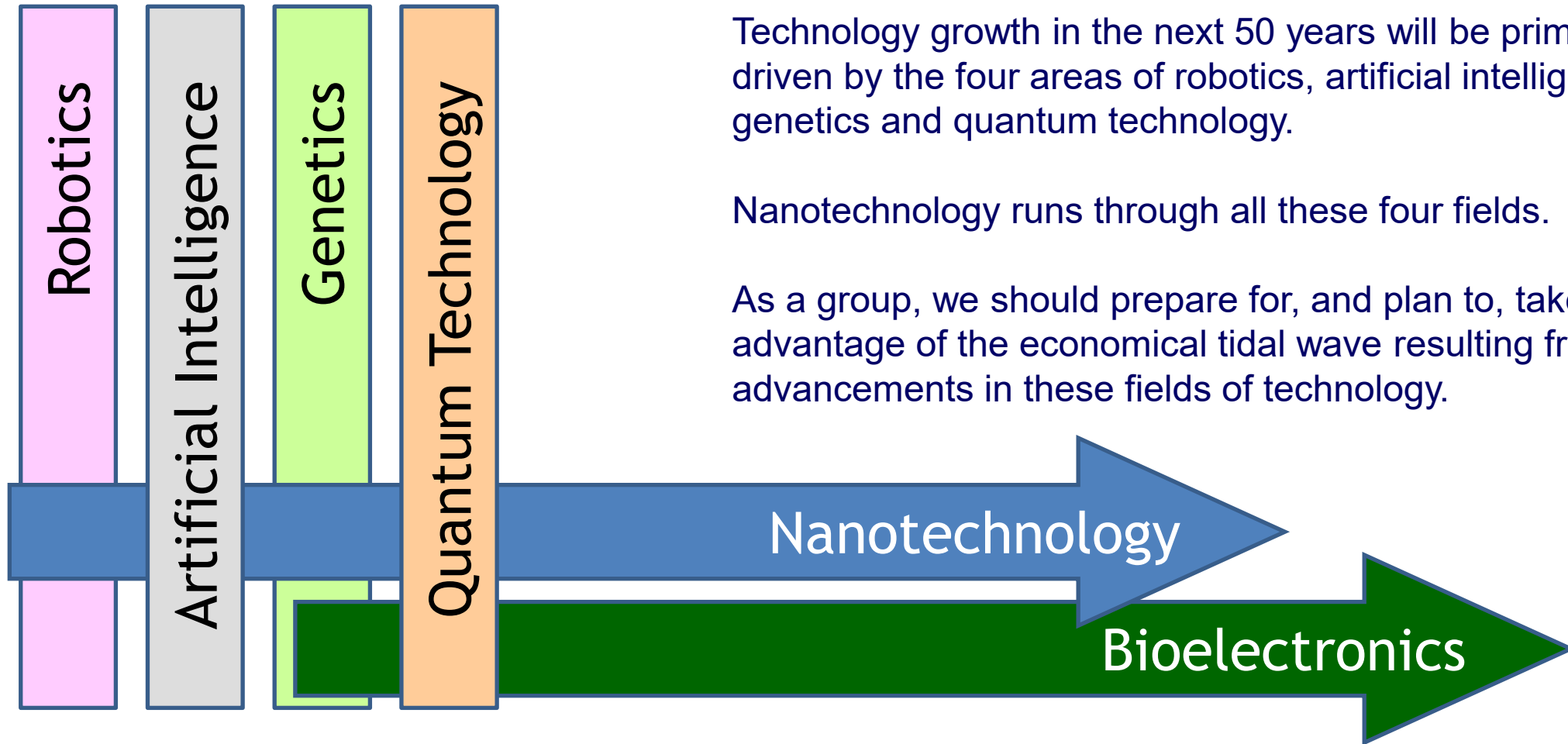
 National Nanotechnology
Coordinated Infrastructure

Rules of Life – NSF Perspective

- **To enable discoveries to better understand -- "rules" of how life functions**
- **To develop research tools and infrastructure**
 - *To further Rules of Life research*
 - *And to provide us with the capacity to approach more complex questions than ever before;*
- **To train the next generation of researchers to approach scientific inquiry in a way that crosses scales and scientific disciplines;**
- **Foster collaboration & convergent research crossing multiple levels of organization & complexity in addressing key questions in the life sciences.**

NNCI - Research Communities - RoL

Technology growth in the next 50 years



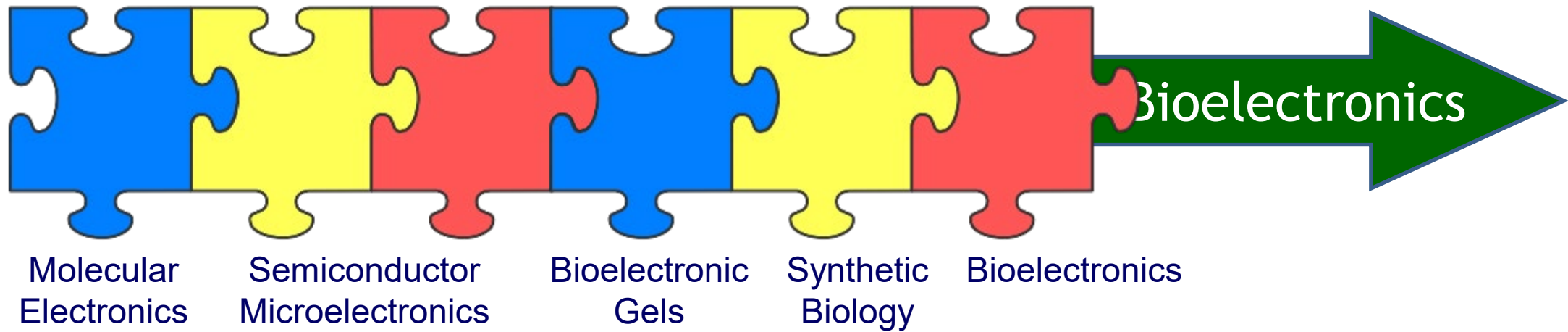
Technology growth in the next 50 years will be primarily driven by the four areas of robotics, artificial intelligence, genetics and quantum technology.

Nanotechnology runs through all these four fields.

As a group, we should prepare for, and plan to, take advantage of the economical tidal wave resulting from advancements in these fields of technology.

NNCI - Research Communities - RoL

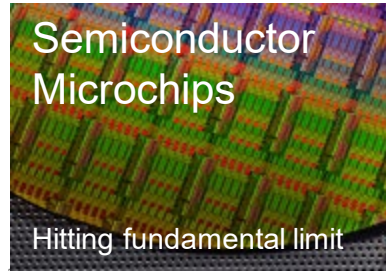
About Rules of Life



Mark Ratner

Landmark paper of Mark Ratner and Arieh Aviram (15 Nov. 1974) "Molecular Rectifiers".
Chemical Physics Letters
29 (2): 277-283

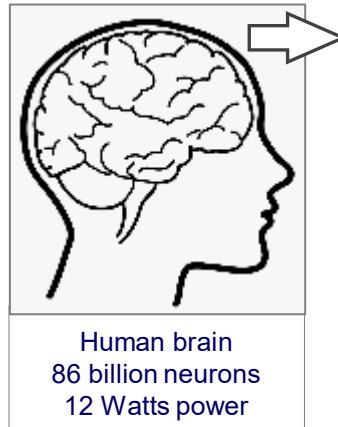
1974



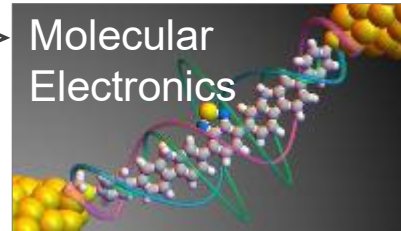
Semiconductor Microchips

Hitting fundamental limit

Transistor densities: ~100M per square millimeter
Transistor size: ~10 nm
Transistors in chip: ~10B

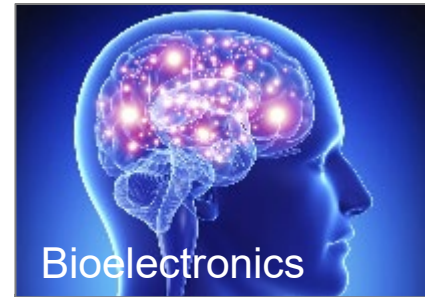


Human brain
86 billion neurons
12 Watts power



Molecular Electronics

Quantum interference enables single-molecule switch with high on/off ratio. Image Credit: Julia Greenwald and Suman Gunasekaran, Columbia Univ.



Bioelectronics

Bioelectronic microchips and bioelectronic computers

Rules of Life – NNCI/Our Perspectives

- **To develop research tools and infrastructure**
 - *To further Rules of Life research*
 - *What are those? Known Knowns*
 - *More complex questions Known Unknowns, Unknown-Unknowns*
- **Themes of NNCI Interest:**
 - *Synthetic Biology Imaging tools/methods AI/ML into RoL*
 - *Specific technical themes:*
 - *Diagnostics/Sensing, Delivery*
 - *Unconventional fields and impact: Agriculture, Food/Water nexus etc.*
- **Strategy to Leverage RoL - Vendor/Webinar events, training, outreach/SEI, ..**
- **Further evolution of RoL RC during 2022-23 academic year.**

Rules of Life – Future Plans & Ideas: **3 Main Efforts?**

- **To develop research tools and infrastructure**
 - *Core ideas – Roadmapping,*
 - *Infrastructure for SynBio: Fab analogy*
 - *Diagnostics/Sensing: Integrating biology with microelectronics/Fab*
 - *Unconventional fields? Ag, Food/Water, space, Astrobio.*
- **Teaching/learning and workforce development**
 - Technical Themes/Seminars – Define and develop RC RoL Themes
 - Case for niche and diverse infrastructure/facilities
- **Public and Societal Outreach/Impact:**
 - Public events and dissemination
 - Workforce Development, community colleges/related

Convergence of Synthetic Biology with Data Science: Promises, Prospects & Perils

April 27, 2022
1:00 - 4:00 PM (CT)
Virtual Event

Speakers:

Michael Jewett, PhD, Northwestern University
Bioengineering Beyond Cells to Enable a Fair and Sustainable 21st Bio-Century

Arvind Ramanathan, PhD, Argonne National Laboratory
FAIR Artificial Intelligence Techniques for the 21st Bio-Century

Austin Clyde, PhD Candidate, University of Chicago
How Does Artificial Intelligence Change the Ethics of Synthetic Biology?

Panel Discussions:

Panel Discussions Moderator
Sera L. Young, PhD, Northwestern University

Register:



<https://bit.ly/3Jdc8Hy>



Understanding the Rules of Life
Research Community of the NNCI
www.nsf.gov/news/special_reports/big_ideas

SHyNE

Soft Hybrid Nanotechn
Experimental Resource



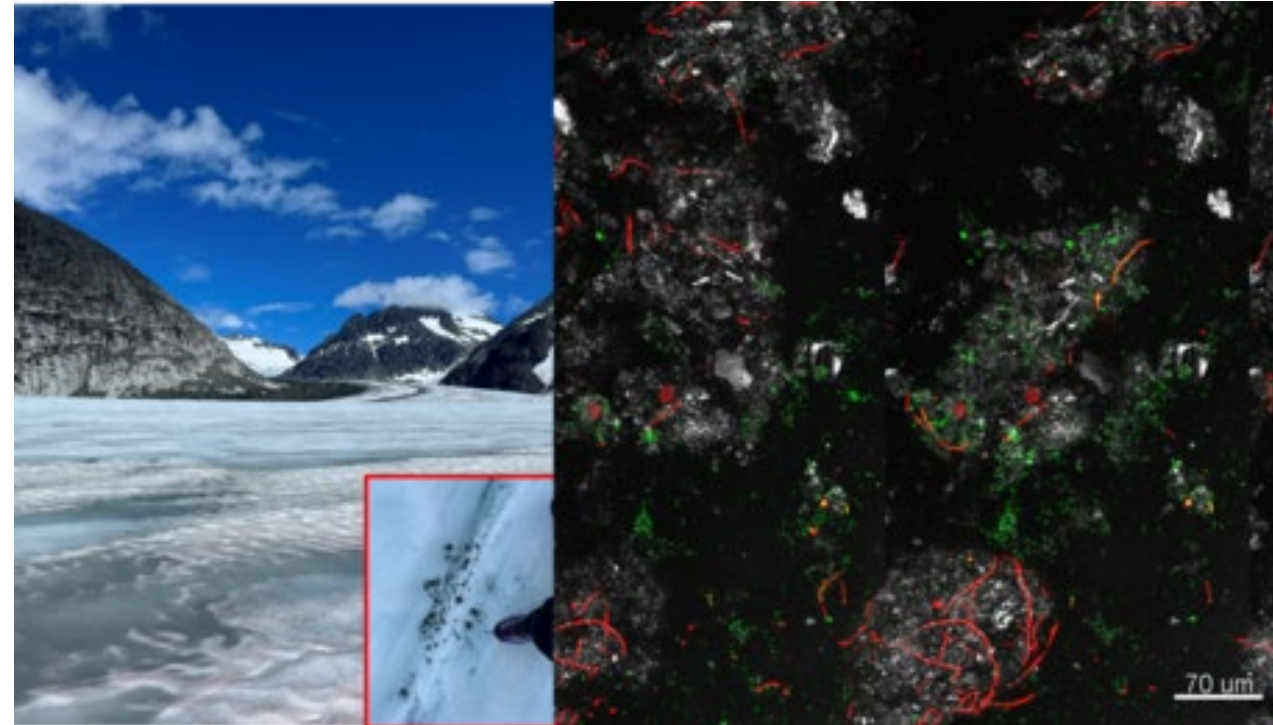
MONT Fall 2022 Virtual Event

The Convergence of Biology and Earth Sciences

Tuesday, November 1, 12-3 PM
(Mountain Time), Online

Montana State University.

[Register](#) by Monday,
October 31, 2022

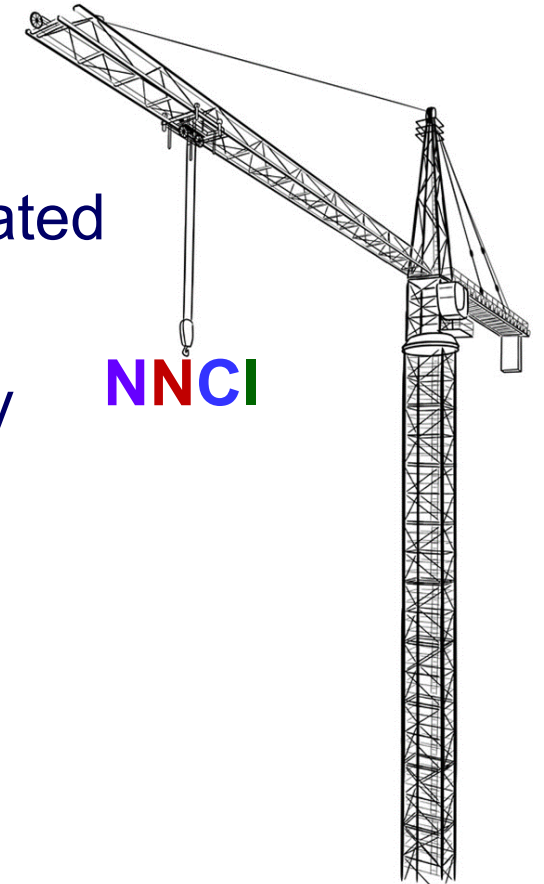


Gilkey Glacier, Alaska. Inset showing cryoconite sediments on glacier surface and confocal microscopy image of biofilm on the sediment surface. Image credits: C. Foreman and H. Smith,

Summary - Research Communities - RoL

RoL - Future Plans and Ideas

- **Complex RoL technical themes:**
 - Broad yet focused and targeted activities
 - RoL webinars, workshops & info series - regionally coordinated
- **Tools & infrastructure issues in RoL:**
 - Thematic emphasis: e.g.; Infrastructure for synthetic biology
 - Diagnostics & sensing - integrating bio- w/ MicroE/Nanofab
 - Imaging - unconventional and multimodal fields
- **Education & workforce development:**
 - Technical seminars & workshops: Infrastructure & facilities
- **Public/Societal Outreach & Impact:**
 - Workforce development, community colleges; related training institutions



*Constructing
Infrastructure*

Q & A

Discussion

RoL- RC: Summary

❖ Closing Comments/Remarks

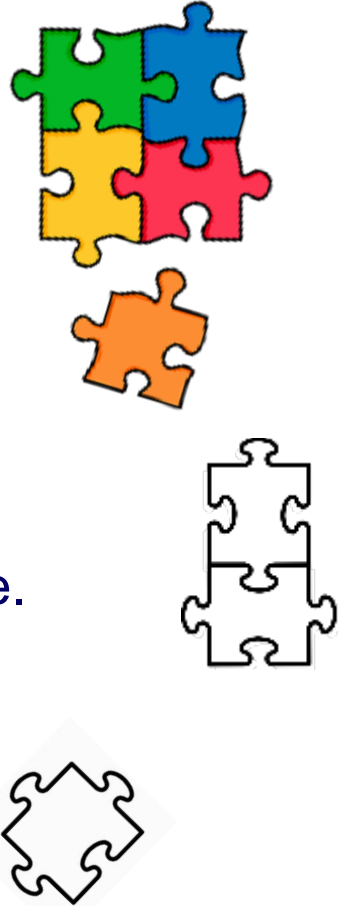
❖ Feedback/Input:

- *Process, plans & specifics*

❖ Next Steps

Research - Roadmap - Education - Commercialization - Workforce Development

- Infrastructure for the RoL related research activities & technology development work.
- Relationships and strategic partnerships: From regional and industrial partners in biotechnology fields
- Rapid technology transfer: new product development centers of industrial commercial companies.
- Enable start-up companies and facilitate success: Entry into market is often infrastructure.
- Successful workforce development:
- Play the role of the local scientific and scholarly community center within our community.



Rules of Life – NSF Programs

- ✓ [Understanding the Rules of Life: Emergent Networks \(URoL:EN\) Predicting Transformation of Living Systems in Evolving Environments](#)
(Program Announcement, Feb. 8, 2021)
- ✓ [Understanding the Rules of Life: Microbiome Interactions and Mechanisms \(URoL:MIM\)](#)
(Program Announcement, Nov. 25, 2020)
- ✓ [Understanding the Rules of Life: Epigenetics](#)
(Program Announcement, Nov. 4, 2019)
- ✓ [Understanding the Rules of Life: Epigenetics](#)
(Program Announcement, Sept. 28, 2018)
- ✓ [Understanding the Rules of Life: Building a Synthetic Cell](#)

Synthetic Biology: Analogous NNCI Example for RoL/RC?

[EBRC Research Roadmap |](#)

[EBRC Research Roadmaps
for the Next-Generation Bioeconomy](#)

SH_yNE – Integrated & Comprehensive Approach

Outreach and Education



- Nano-Journalism, Social Media
- Nanotech Exhibits, Museums
- Lecture series, iNANO, M3S



- Industry Workshops, Demos
- Vendor Relations
- SEED Funding, Targeted Marketing



- Seminars, Courses, User meetings
- Technical Workgroups
- Proposal Development



- REU – Workforce Development
- CC Internship Program
- Open House, Image Contest



- RET - curriculum Development
- Science in Society (SiS) - camps, science clubs, Boys/Girls Clubs, URM
- Lab Tours, Demos, Remote Learning

Public, Community

Industry, Entrepreneurs

University, Faculty

Comm. College, Undergrad

K-12

Diversity and Inclusion

- Science Chicago, Regional outreach
- Chicago Museums, URM community
- Women in Nano, SWE, SBE hiring



- Diversity Survey - demographics
- - external user onboarding
- - Improved tracking and metrics



- Targeting URM universities
- Diversity Survey – demographics
- Coordination: Dean Williams



- SHyNE REU - 100% Women/URM
- Community College interns
- MRSEC REUs



- RET 100% URM teachers
- SiS Targets Chicago schools,
- Diversity Survey – demographics
- Tracking outcomes



Rules of Life – NNCI/Our Perspectives

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- **Themes of NNCI Interest:**
 - *Synthetic Biology* *Imaging tools/methods* *AI/ML into RoL*
 - *Specific technical themes:*
 - *Diagnostics/Sensing*
 - *Unconventional fields and impact: Agriculture, Food/Water nexus etc.*
- **Vendor/Webinar events, training, outreach?**
- **Out-of-box ideas/plans**