

Center for Land Use, Climate Change and Sustainability (CLCS)

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INSTITUTE FOR ENVIRONMENTAL GENOMICS

UNIVERSITY OF OKLAHOMA

Grand Challenges

Population, Food

Over-reliance on fossil fuels

Climate changes: rising greenhouse gases emissions, changing patterns of precipitation, extreme weather...

Agriculture: high external input

Conservation Reserve Program, Reforest ...

Urbanization
Deforest ...

Forest/grassland: fire

Biofuels

Sustainability?

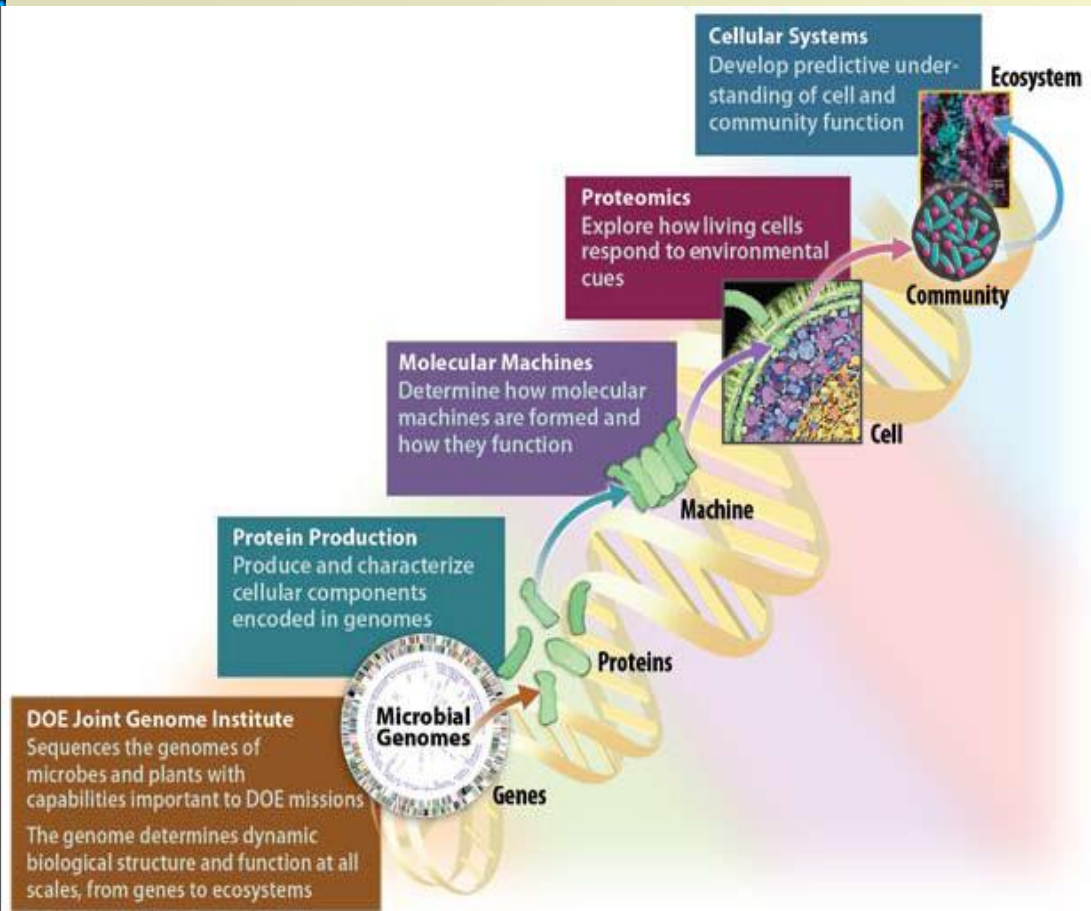


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Scientific Goal

To understand ecological consequences to land use practices/changes in scenarios of climate change;
To evaluate sustainability of managements in response to locally, regionally and globally environmental changes.



- Linking genomics to life
- Linking biodiversity to ecosystem functioning
- Impacts and prediction of global changes on ecosystem services



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Some key scientific questions

- **How do locally, regionally and globally environmental changes (land practices/changes and climate changes) affect plant and microbial community composition, structure, and ecosystem functioning?**
- **Are there linkages among aboveground plant diversity, belowground microbial diversity and ecosystem functions? If so, how do those environmental changes impact such linkages?**
- **What is the network interaction in a ecosystem between microbes and plants, and among community members within a plant or microbial community? How do those environmental changes affect such interactions?**
- **How can information be scaled from molecule to cell, population, community, and ecosystem for understanding ecosystem behaviors?**

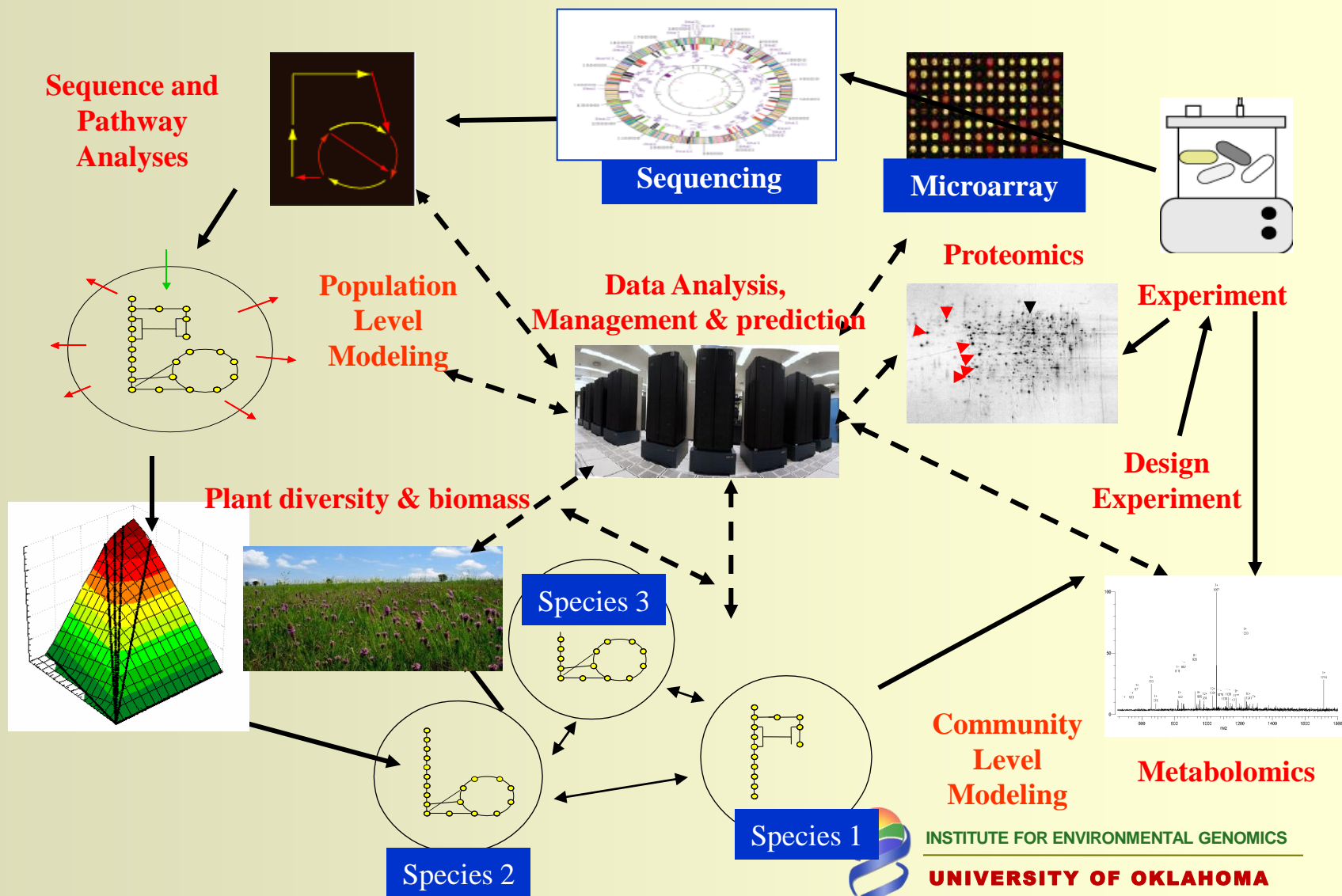


Available facilities and approaches

- **Experimental sites related to warming, fertilization, grass fire, and greenhouse gas studies;**
- **GeoChip technologies and facilities;**
- **High throughput sequencing technologies and facilities;**
- **Metatranscriptomics/RNA-Seq, metaproteomics and metametabolomics;**
- **High throughput computation;**
- **Data assimilation and modeling.**



Integrative approaches to address big frontier scientific questions



Scientific objectives/subprojects

- **Subproject 1. (Production).** Understanding the effects of plant/microbial diversity on feedstock/crop production and ecosystem functional processes.
 - LIHD (Low Input High Diversity), productivity, managements
 - Soil C/N dynamics, greenhouse gases
 - Microbial community structure, GeoChip, stable isotope probing
- **Subproject 2. (Sustainability)** Understanding the effects of global changes on feedstock/agricultural production and sustainability
 - Interactive effects: Clipping, CO₂, warming, precipitation
 - Plant, microbial dynamics, greenhouse gases
- **Subproject 3. (Rhizosphere Community Genomics)** Metagenomic analysis of microbial communities for plant-microbe interactions
 - Microbial isolation, Community sequencing, GeoChip development
- **Subproject 4 (Systems biology and ecology)** Developing integrated models to scale information across different organization levels towards predictive understanding of production and sustainability

Why EPSCoR?

- Fundamental enough to be interesting to NSF
- Our strengths
 - Pioneers in genomics technology development (IEG), genome sequencing, global change ecology, and gasification technologies
 - Leadership in functional genomics, leaders in plant genomics, switchgrass studies



Significance & Deliveries

- **Advanced scientific understanding & knowledge on frontier biological questions**
- **Central facilities**
 - Experimental field facility for long-term studies on biofuel plant diversity and plant-microbe interactions related.
 - Experimental facility for integrative studies of global changes, ecosystem sciences and bioenergy
 - Laboratory facility for proteomics/metabolomics
 - System biology center: high throughput and computational center for dealing large scale of data analysis in genomics, ecology, and global changes
- **Scientific teams and expertise at OK:**
 - Integrative team to know how to work together
 - Core expertise in interdisciplinary sciences
 - Many postdocs, graduate, undergraduate and K12 students will be trained
 - Several new faculty across different fields will be supported



Outreach: broader impacts

- 1. Graduate student and postdoctoral training.**
- 2. Undergraduate science education and K-12 students and educators.**
- 3. Enhanced diversity.**
- 4. Teaching.**
- 5. International Conferences and workshops.**
- 6. National Policy on Climate Change and bioenergy.**
- 7. Web site**



Projected Sustainable Funding

- NSF National Ecological Observatory Network (NEON) program
 - A major funding mechanism to support ecological and environmental research in the next 30-50 years.
 - Covers biodiversity, biogeochemical cycles, and global change, supported by NEON.
 - Could be a central facility to be supported by NEON.
 - GeoChip highlighted by NEON
 - NEON Workshop on data simulation organized by Dr. Luo
- DOE global change programs
 - Direction change to multifactor experiments, great opportunity
 - Dr. Luo receives significant funding from these program
- DOE Genomics:GTL program:
 - Major funding program for basic research in bioenergy
 - Dr Zhou is very successful in receiving funding from this program



Potential team members

OU

- Jizhong Zhou: functional genomics, genomics technology, microbial ecology
- Yiqi Luo: theoretical ecology, and modeling, simulation and prediction
- Ralph Tanner: Microbial physiology of gasification
- Joseph Suflita: Microbial physiology, metabolites
- Bradley Stephenson: Microbial ecology and genomics
- Lee Krumholtz: Microbial ecology
- Zhili He: Bioinformatics, microbial genomics
- Bruce Roe: Genome sequencing
- Mark Nanny: Metabolomics
- S. Lakshmivarahan: High throughput computing

OSU

- Michael Palmer: Plant biodiversity
- Babu Fathepure: Microbiology
- Mostafa Elshahed: Microbiology
- Michael Anderson: soil science
- Shiping Deng: soil science
- Yanqi Wu: Plant genetics

Noble Foundation

- Rick Dixon: Plant genomics
- Michael Udvardi: N fixation
- Lloyd Sumner: Metabolomics
- Xiaoqiang Wang: Plant genomics

