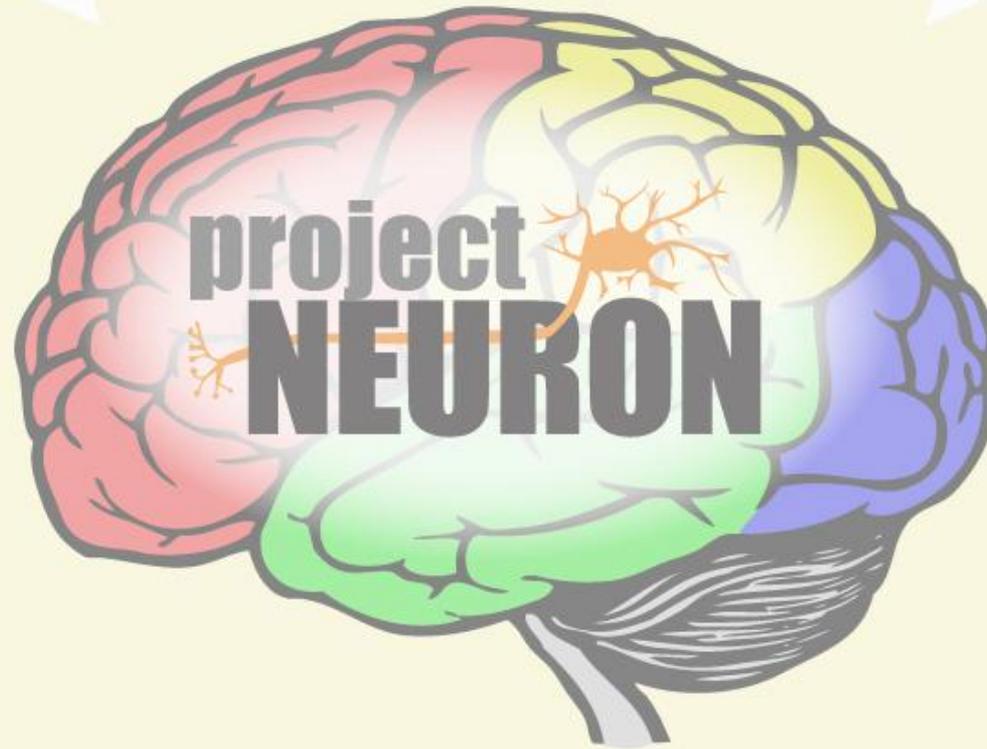


# The Changing Model of the Tree of Life



*Chandana Jasti & Barbara Hug*  
*University of Illinois*



National Institutes  
of Health

**SEPA** SCIENCE EDUCATION  
PARTNERSHIP AWARD  
Supported by the National Institutes of Health

# What is Project NEURON?

- At the University of Illinois
- Educators, scientists, and graduate students
- Curriculum development
  - Inquiry-based
  - Connect to standards
- Professional development
  - Summer institutes
  - Conferences



# Project NEURON Curriculum Units

- **Do you see what I see?**
  - *Light, sight, and natural selection*
- **What can I learn from worms?**
  - *Regeneration, stem cells, and models*
- **What makes me tick...tock?**
  - *Circadian rhythms, genetics, and health*
- **What changes our minds?**
  - *Toxicants, exposure, and the environment*
  - *Foods, drugs, and the brain*
- **Why dread a bump on the head?**
  - *The neuroscience of traumatic brain injury (TBI)*
- **Food for thought: What fuels us?**
  - *Glucose, the endocrine system, and health*
- **What makes honey bees work together?**
  - *How genes and environment affect behavior*
- **How do small things make a big difference?**
  - *Microbes, ecology, and the tree of life*

Available at:  
[neuron.illinois.edu](http://neuron.illinois.edu)

# An Iterative & Collaborative Development Process



**Determine main understanding goals and develop unit outline**



**Develop and revise lesson plan and student materials**

**Scientists provide feedback  
(Whitaker Lab)**

**Teachers provide feedback  
(based on workshops and classroom enactments)**

# The Curriculum Unit

How do small things make a big difference?

*Microbes, ecology, and the tree of life*

- Lesson 1: How did the tree of life change through history?
- Lesson 2: What is the current tree of life model?
- Lesson 3: What do microbial communities look like?
- Lesson 4: How do microbes interact with humans?
- Lesson 5: What happens when my microbiome is disturbed?

# The Nature of Science in the NGSS

## (NGSS - Appendix H)

- “The integration of scientific and engineering practices, disciplinary core ideas, and crosscutting concepts sets the stage for teaching and learning about the nature of science.”
- The NOS Matrix (handout)
  - Learning outcomes for 8 major NOS themes
- Implementing Instruction
  - Students be metacognitive about NOS after doing the practices
  - Case studies from the history of science

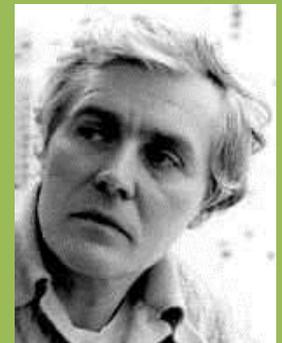
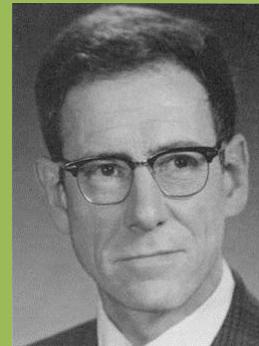
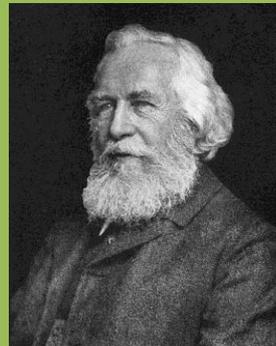
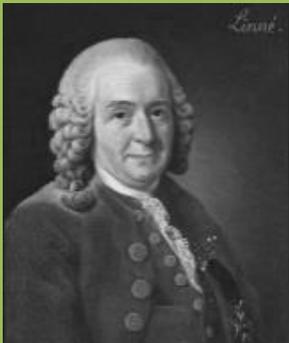
**\*Take a couple of minutes to read these and keep them in mind as we go through the lesson.**

# Lesson 1: How did the tree of life change through history?

## Lesson 2: What is the current tree of life model?

### Learning Objectives

- Explain how and why scientific models can change over time (within the context of the tree of life model case study)
- Explain the role of technology in the advancement of science
- Explain how the model of the tree of life changed throughout history
- Describe the current tree of life model and the technology/evidence used to discover it

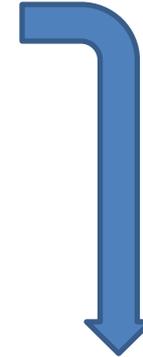


# “Tree of Life”

On a sheet of  
paper, draw  
what you think  
of when you  
hear the term  
“tree of life”.

# Activity: Tree of Life Timeline

- Work in groups of 3-4
- Use the student sheet as a guide
- Focus on the big picture
- 20 minutes



## Outline of steps:

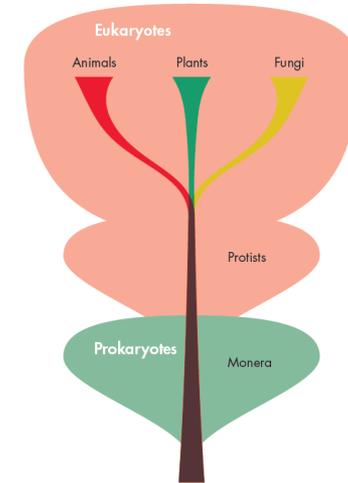
- Step 1: 1758 A → 1758 B
- Step 2: 1866 A → 1866 B
- Step 3: 1969 A → 1969 B

# Tree of Life Timeline

Animals

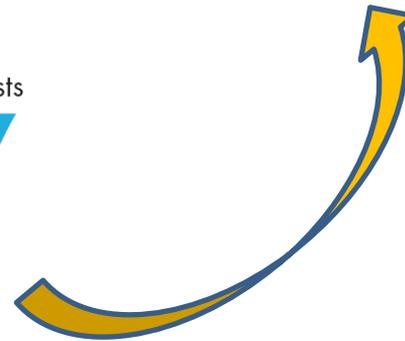
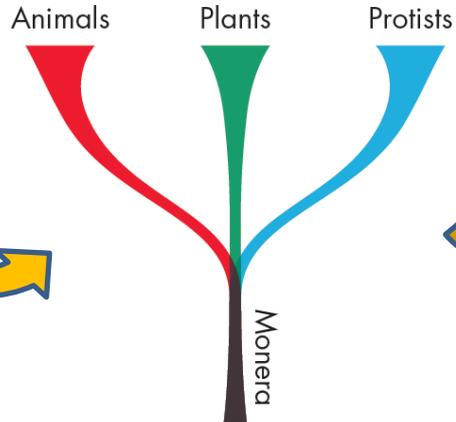
Plants

Linneaus (1758)



Whittaker (1969)

Haeckel (1866)

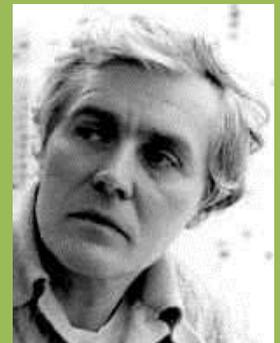
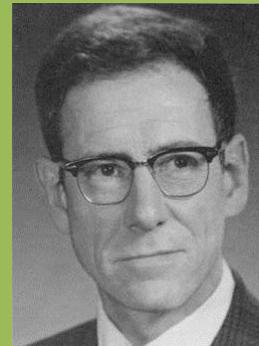
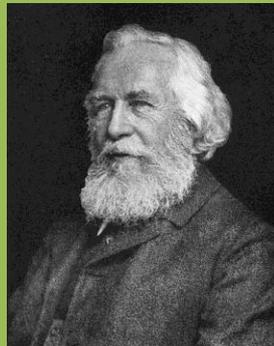


# Lesson 1: How did the tree of life change through history?

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### Learning Objectives

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# 1990 A

- In the 1970s, advances in science and technology allowed scientists to examine genetic information found in DNA and RNA to determine the relationships between species. Using the reasoning that groups of organisms with a lot of genetic information in common were more closely related to each other than others that had less in common, scientists began to reorganize the tree of life...



# Activity: Molecular Tree of Life

*Bacteroidetes* sp.

ACATTATCCACTGTGTCCTTCTGCAGTATCGGGCCATTTGAGCCT

*Giardia intestinalis*

AGGGTTTCAACCCTGTGTCCTTCTGCAGTATCGGGCCATTTGAGCCT

*Methanosarcina* spp.

AGGGTATCAACTGTTTCCACTTTTCTGCAATATCGGGCTATTTGAGCCT

*Sulfolobus islandicus*

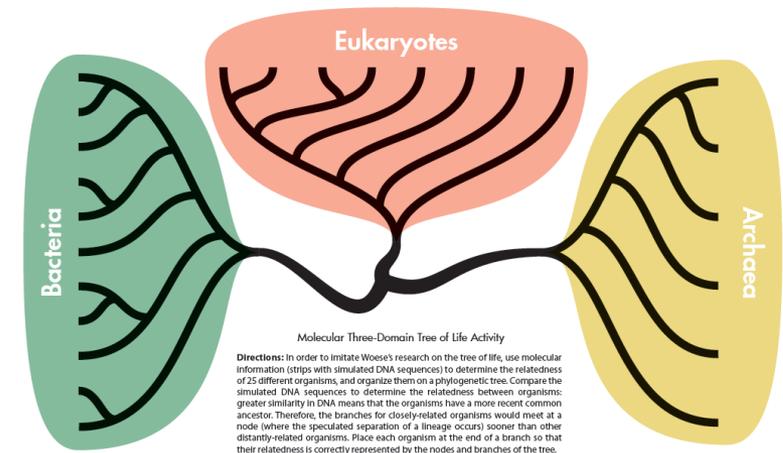
AGGGTATCAACTGAGTCCACTCTTCTGCAGTATCGGGCCATTTGAGCCT

*Thiobacillus* spp.

ACATTATTAAGTGTGCCACTCTGCTGCAGTTTTCGGGCCACTTGAGCCT

*Acinonyx jubatus*

AGGGTTTCAACTCTGTCCACCCTTCTGCTGTATCGGACCATTGGAGCGT



# Discussion

- How could you use these lessons in your classroom?
  - To teach about the Nature of Science?
- How might you modify these materials to fit with your curriculum?

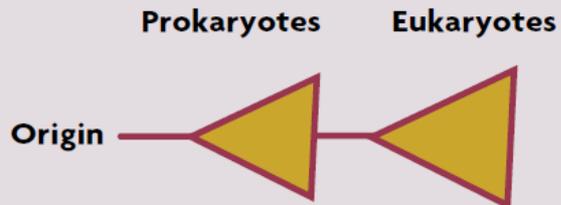
# The Nature of Science

**FIGURE 1B**

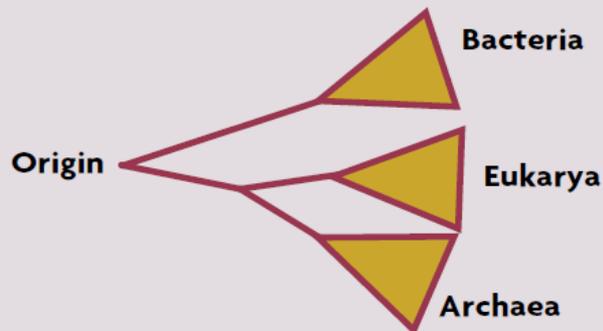
## The three-domain molecular tree of life.

Cartoons of the two models of evolution. The triangles indicate divergences of genetic lines (e.g., species) within the groups represented by each triangle.

### Previous model: Eukaryotes evolve from prokaryotes



### Current model: Three domains with a common origin



Baumgartner, L.K. & Pace, N.R. (October 2007)

- How does this figure exemplify the nature of science?
- Does it have implications for how you teach Biology?

# Acknowledgements

- NIH, SEPA
- University of Illinois
  - Project NEURON
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# Thanks!

For additional information visit:  
**<http://neuron.illinois.edu>**

E-mail:  
**[neuron@illinois.edu](mailto:neuron@illinois.edu)**

The screenshot shows the Project NEURON website homepage. At the top left is the University of Illinois logo. In the center is a stylized brain with the text "project NEURON" overlaid. To the right of the brain is a search bar and a "Log in/Create account" link. Below the header is a navigation menu with links for "Curriculum Units", "Professional Development", "Games and Media", "Additional Projects", and "About". The main content area features the title "Project NEURON" and the subtitle "Novel Education for Understanding Research on Neuroscience". A section titled "Find out more about our 2013 Summer Professional Development!" contains text about the project's goals and core activities. Below this is a "News and Events" section with three items: "Color Sorting Activity in The Science Teacher" (March 23, 2013), "Color Sorting Game is Back Online" (February 20, 2013), and "Project NEURON at 2013 Public Engagement Symposium" (February 6, 2013). On the right side of the news section is a "Neuroscience Day" poster for two events: one at Marina Inn in Sioux City, NE on March 19, and another at Siena Galleria in Mission, SD on March 20. The poster includes a brain icon and the time "9:00 - 3:00 with lunch provided".