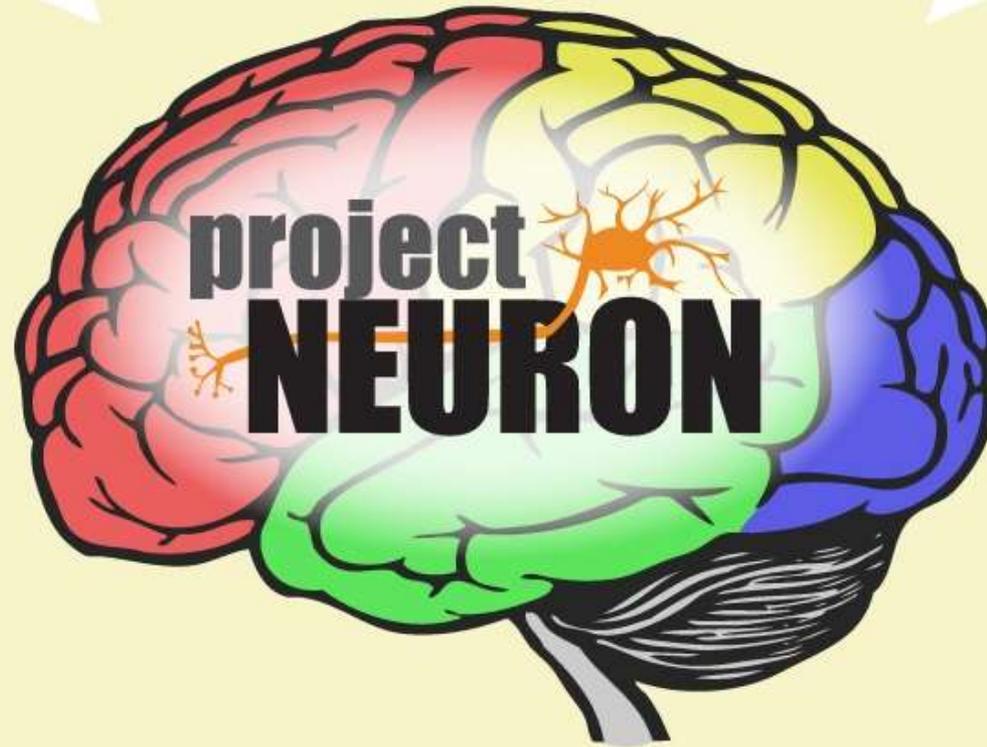


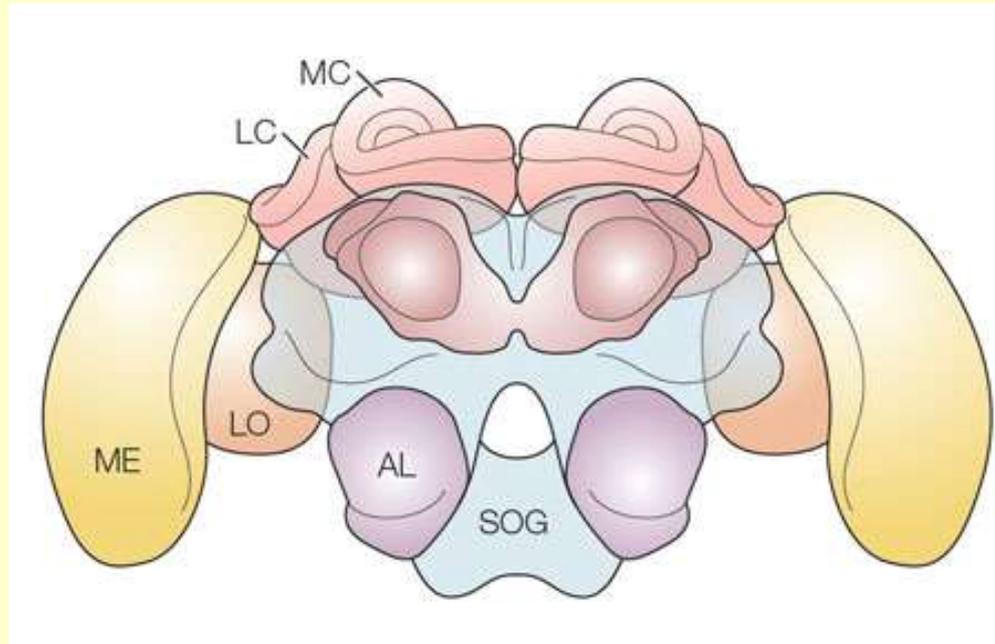
What makes honey bees work together? *How genes and environment affect behavior*



*Claudia Lutz, Rob Wallon, Claire Scavuzzo,
Sara Patterson Adamek, Barbara Hug
University of Illinois*



What makes honey bees work together? *How genes and environment affect behavior*



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Session Overview

- What is Project NEURON?
- Introduce the curriculum unit
- Experience two hands-on activities from the unit
- Discussion and feedback



What is Project NEURON?

- Curriculum development
 - Inquiry-based
 - Connect to standards
- Professional development
 - Summer institutes
 - Conferences
- Educators, scientists, and graduate students



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 microbes make a big difference?**
 - *Microbes, ecology, and the tree of life*

Available at:
neuron.illinois.edu

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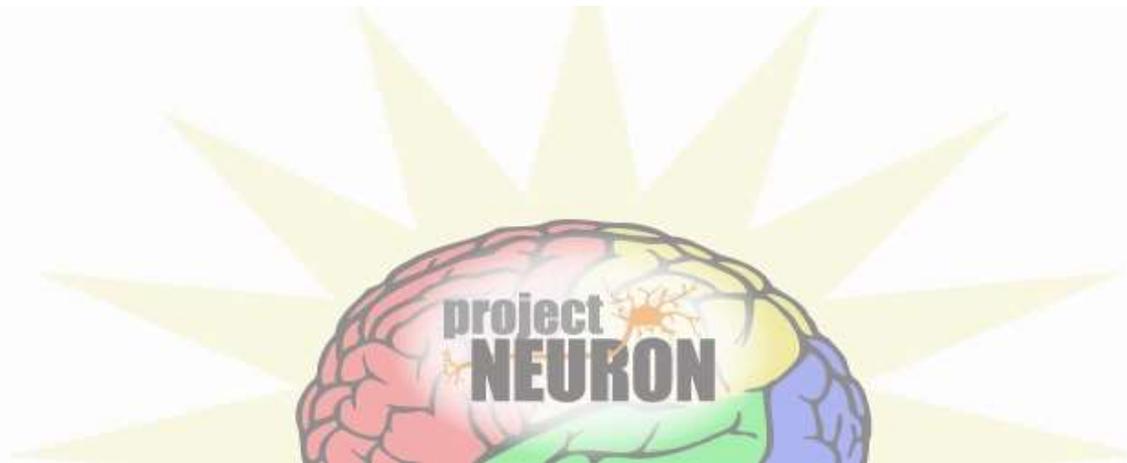
Collaborative curriculum development

- **Science Educators (Project NEURON)**
 - Initial unit planning
 - Developing lessons
 - Modify/revise materials based on feedback
- **Scientists (Robinson lab)**
 - Initial unit planning
 - Provide feedback on lesson content
- **Teachers (High School Science)**
 - Initial unit planning
 - Enact lessons in the classroom
 - Provide feedback



The Curriculum Unit

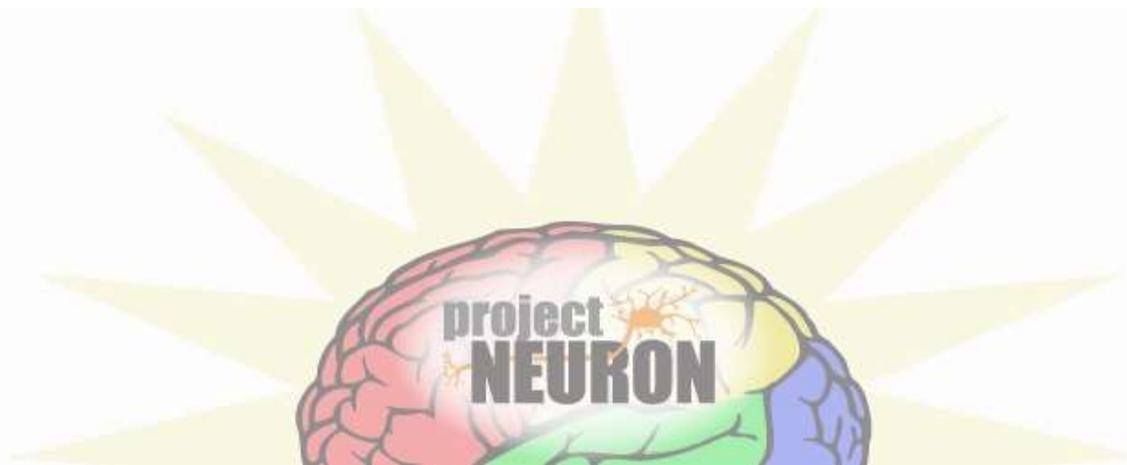
What makes honey bees work together?



The Curriculum Unit

What makes honey bees work together?

Brainstorm factors that influence animal behaviors
(humans are animals too!)

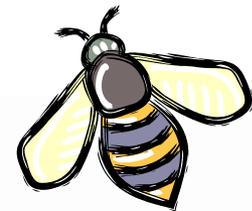


The Curriculum Unit

What makes honey bees work together?

Brainstorm factors that influence animal behaviors
(humans are animals too!)

- Genetics (nature)
- Environment (nurture)



The Curriculum Unit

What makes honey bees work together?

- Lesson 1: What do honey bees do?
- Lesson 2: Why do honey bees have different jobs?
- Lesson 3: How do honey bees heat the hive?
- Lesson 4: What is the genetic basis for the evolution of eusocial behaviors?



The Curriculum Unit

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Lesson 1: What do honey bees do?

Learning Objectives

- Generate questions about honey bees
- Identify honey bee behaviors
- Describe influences on behavior

So . . . what do honey bees do?

Lesson 1: What do honey bees do?

Learning Objectives

- Generate questions about honey bees
- Identify honey bee behaviors
- Describe influences on behavior



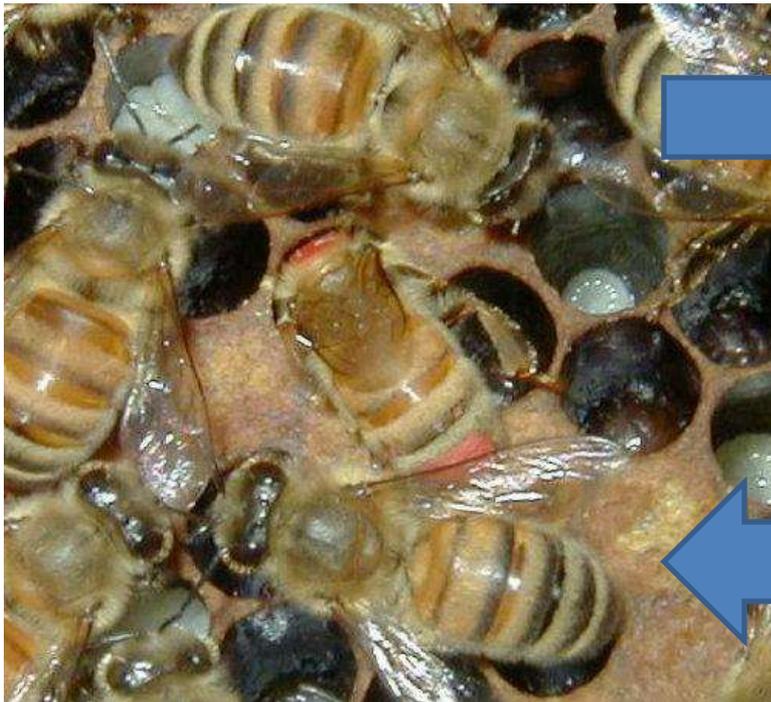
Lesson 1: What do honey bees do?

- Nurse bees (days 3-11)
- Forager bees (days 14-42+)



Lesson 1: What do honey bees do?

- Nurse bees (days 3-11)
- Forager bees (days 14-42+)



The Curriculum Unit

What makes honey bees work together?

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Lesson 2: Why do honey bees have different jobs?

Learning Objectives

- Describe the **concept of gene expression**
- Explain how **gene expression influences the behavioral** roles of honey bees
- Model how the **environment influences the behavioral** roles of honey bees

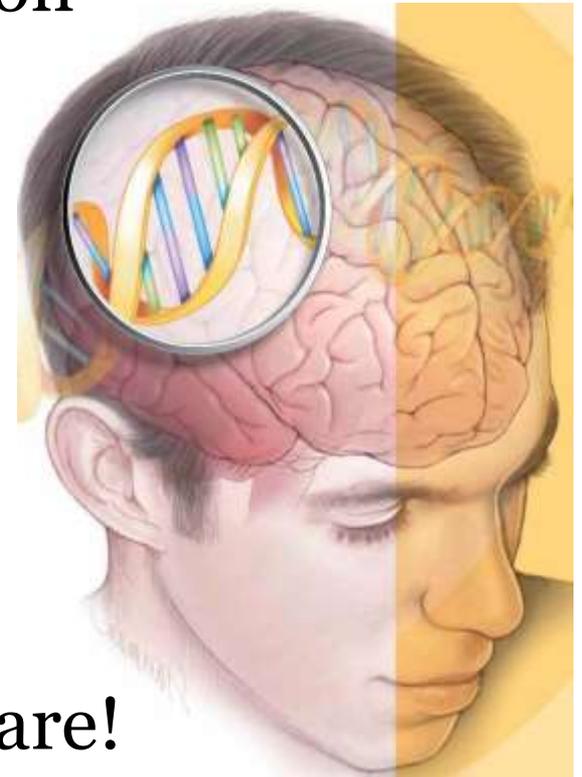
AP Biology Big Idea 3:

“Living systems store, retrieve, transmit and respond to information essential to life processes.”

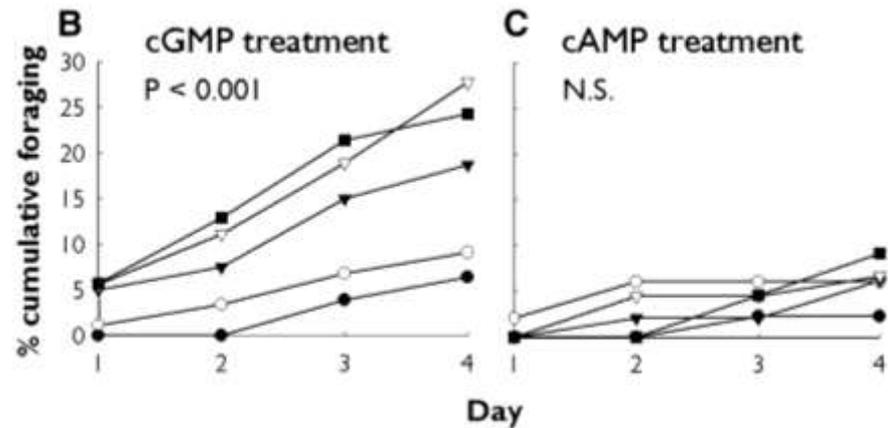
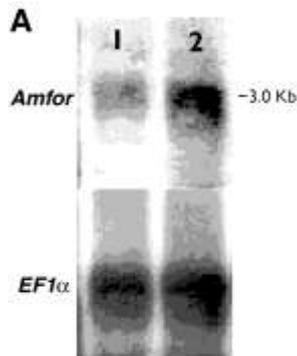
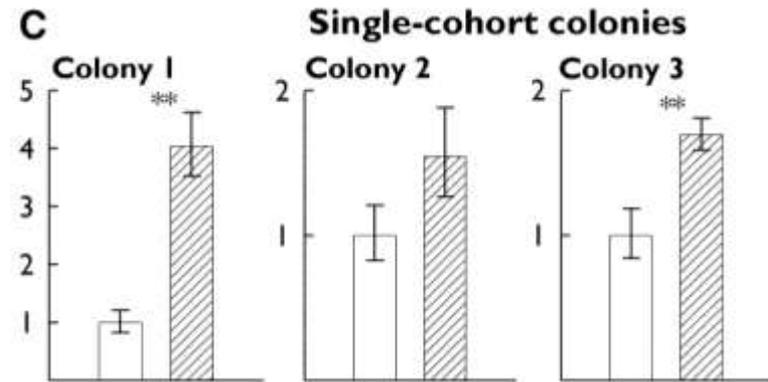
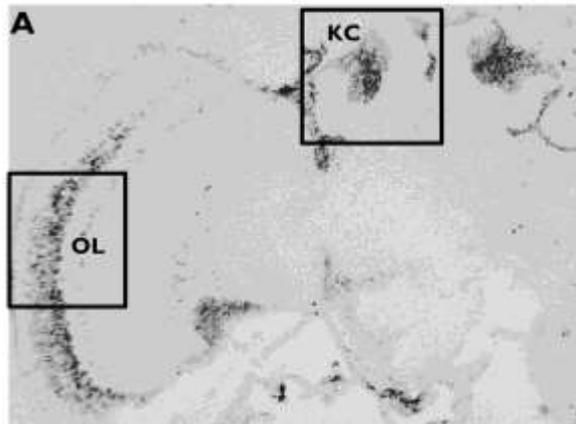
Activity: Analyzing gene expression data

Reading and data interpretation activity

- Everyone: background information
- Groups:
 - Experiment 1
 - Experiment 2A
 - Experiments 2B and 3
 - Experiments 4A and 4B
- Discuss in groups, be ready to share!

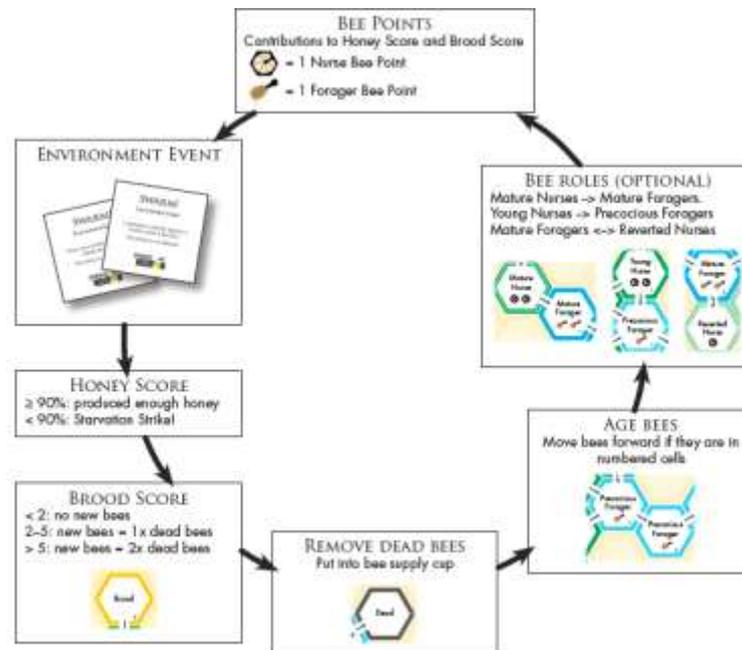


Analyzing gene expression data: Discussion



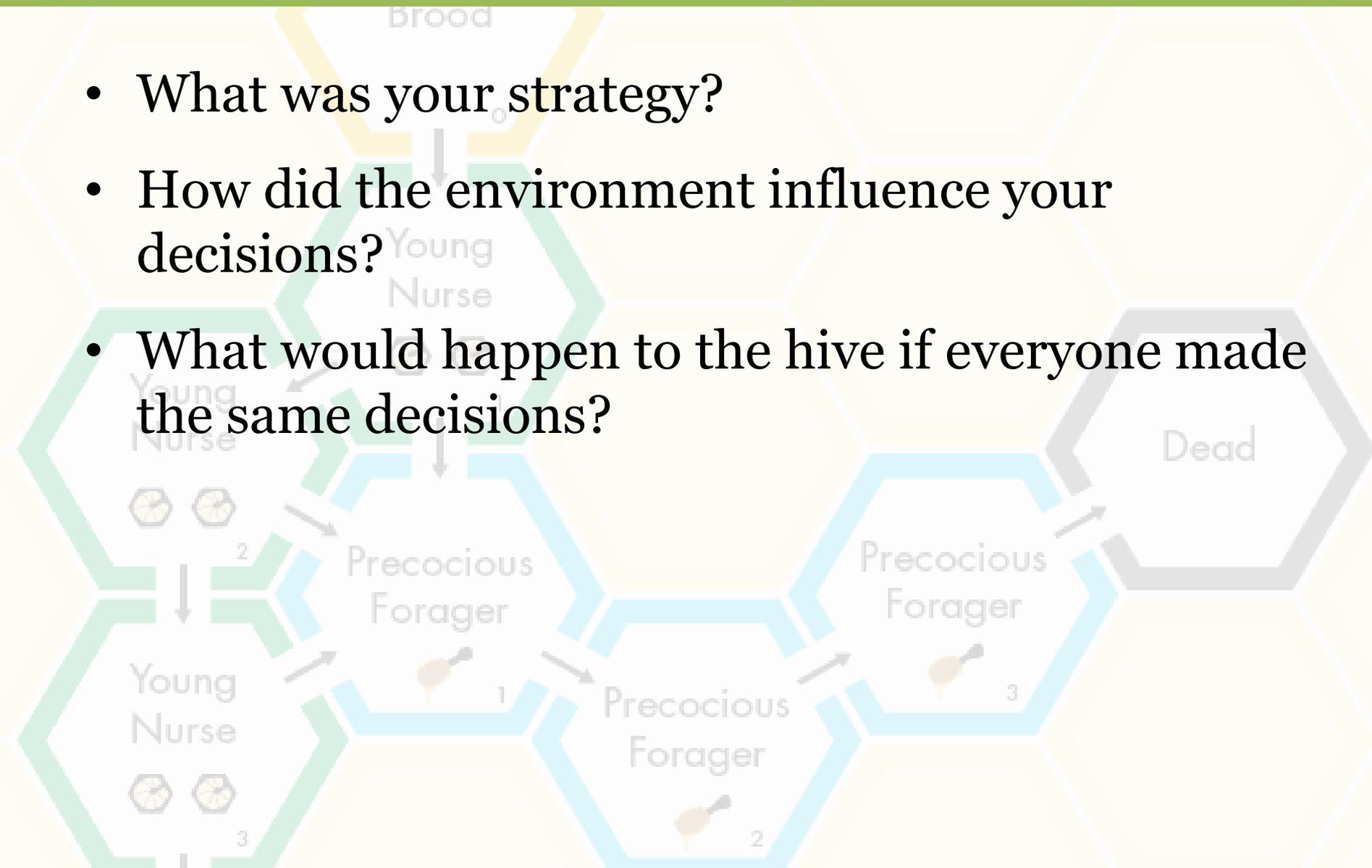
Activity: Swarm!

- Look over game rules
- Boards will already be set up for play
- Keep the hive alive!



Swarm!: Discussion

- What was your strategy?
- How did the environment influence your decisions?
- What would happen to the hive if everyone made the same decisions?



The Curriculum Unit

What makes honey bees work together?

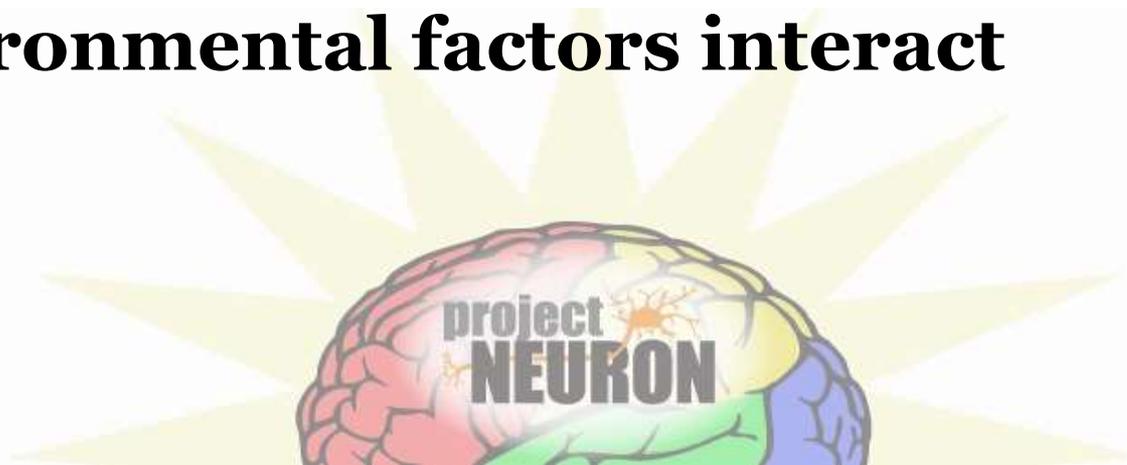
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Lesson 3: How do honey bees heat the hive?

Learning Objectives

- Apply the concept of **homeostasis** to a social group
- Investigate the **effect of temperature on bee behavior**
- Develop a model for **how genetic and environmental factors interact**



The Curriculum Unit

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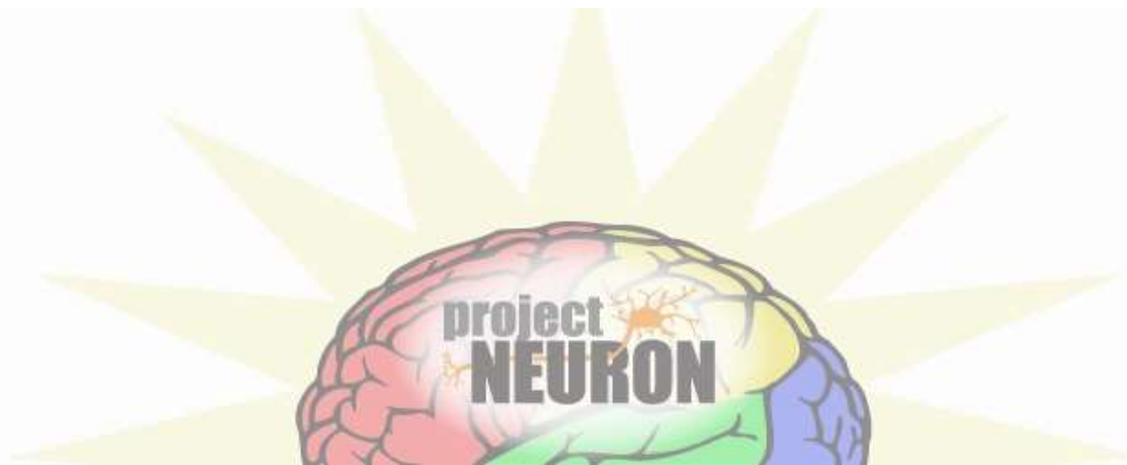
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“Branch Out With Software to Create Phylogenetic Trees”

- Time: Friday, November 22nd 2:30 PM - 3:45 PM
- Location: Dunwoody Room

Discussion

- How could you use these lessons in your classroom?
- How might you modify these materials to fit with your curriculum?



Acknowledgements

- NIH, SEPA
- University of Illinois
 - Project NEURON
 - Robinson Lab
 - Institute for Genomic Biology

This project was supported by SEPA and the National Center for Research Resources and the Division of Program Coordination, Planning, and Strategic Initiatives of the National Institutes of Health through Grant Number R25 RR024251-03. The contents of this presentation are solely the responsibility of Project NEURON and do not necessarily represent the official views of the funding agencies.

Thanks!

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

E-mail:
neuron@illinois.edu

The screenshot shows the Project NEURON website homepage. At the top, there is a navigation bar with the Illinois state logo and the text "ILLINOIS". To the right of the logo is a search box and a "log in/Create account" link. Below the navigation bar is a large banner featuring a colorful brain graphic with the text "Project NEURON". Underneath the banner is a main heading "Project NEURON" and a subtitle "Novel Education for Understanding Research on Neuroscience". The main content area contains several paragraphs of text, including a section titled "Find out more about our 2013 Summer Professional Development!". On the right side of the main content area, there is a red-bordered box titled "Neuroscience Day" containing information about events in S. SIOUX CITY, NE and MISSION, SD. At the bottom left, there is a "News and Events" section with several entries, including "Color Sorting Activity in The Science Teacher" and "Project NEURON at 2013 Public Engagement Symposium".