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

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University of Illinois
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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 N EURO N?

- Curriculum development
  - Inquiry-based
  - Connect to standards

- Professional development
  - Summer institutes
  - Conferences

- Educators, scientists, and graduate students
• 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
Project NEURON Curriculum Units

• Do you see what I see?
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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
What makes honey bees work together?
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Brainstorm factors that influence animal behaviors (humans are animals too!)
What makes honey bees work together?

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

• Genetics (nature)
• Environment (nurture)
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?
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?
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+)
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- Nurse bees (days 3-11)
- Forager bees (days 14-42+)
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?
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?
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?
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**
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“Branch Out With Software to Create Phylogenetic Trees”

• Time: Friday, November 22\textsuperscript{nd} 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

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  – Project NEURON
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Thanks!

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

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