Case Study Pedagogy and Learning Outcomes: A Framework for Teaching Biology with Narratives

NARST-Sponsored Session

Objectives

The session will allow you to:
1) Define case study pedagogy
2) Consider how to incorporate case studies into your course that align to your content goals
3) Structure activities for inclusive small group work

Why lecture when you can tell a story?

Case Study Pedagogy

A learner-centered approach that uses narratives/stories and open-ended questioning to deliver science content

What is Case Study Pedagogy?

- Narrative
  - A robust narrative with an engaging story and dialogue
  - Can be interrupted to deliver/review content
  - Scaffolded to build knowledge

- Problem
  - Poses a real-world dilemma or problem(s) to solve
  - Contains open-ended questions for students to work with content and concepts
  - Can introduce a lab procedure or technique

- Facilitator
  - Instructor acts as a facilitator of knowledge
  - Structure small group work
  - More knowledgeable other

Who's Your Daddy?

(Hunter & Zwick)

- Narrative about a mule giving birth and a paternity dilemma

Theoretical Foundations for Case Studies

- Constructivism (Jonassen, 1999)
- Learner brings own ideas, knowledge, and attitudes to the learning situation
- Case-based reasoning (Kolodner, 1992)

Conceptual Framework for Case Studies in Biology

- Role of prior knowledge
- Transfer of knowledge
- Content, concepts, critical thinking
- Situational interest
- Attitudes toward learning
- Feelings of inclusion

(Hunter 2018, Hunter, Zwick, Galindez in progress)
The Missing Microbe
(Hunter, Zwick, & Galindez)

Narrative about a cheesemaker's microbial dilemma

Conceptual Framework

Triggers
Interest
Narrative
Role of the
Storyteller
Real World Connection
Understanding Biology

Pedagogical Features
Small Group Work
Role of Instructor
Participatory Environment

Transfer of Knowledge
Feelings of Inclusion
Situational Interest

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How Can Biology Content and Concepts be Delivered Through Case Studies?

Let's begin with a story...
The Missing Microbe by Coralys Galidez and Ally Hunter
Sofia Vidal, a Uruguayan farmer, lives in a rural community in San Jose and oversees her family's farm. One aspect of the farm uses milk from cows and goats to produce cheese. The high-quality artisanal cheese is produced using Uruguayan traditions and is the most lucrative aspect of the farm.

One day, Sofia went into her cheese cave to check on her cheese. When she opened the door, she was overwhelmed by a horrible smell. When she saw her cheese, it had the wrong consistency, and the entire batch was ruined. She instantly grew worried and had no idea what happened to her cheese!

Content Delivery

Interrupted Narrative
Part I: Sofia’s Bad Day
Part II: Sofia Calls for Help
Part III: The Missing Microbe Inside Dr. Rodríguez’s Laboratory
Part IV: Milking Mystery
Afterword

Learning Outcomes
List the steps of cheesemaking and describe the role of bacteria in cheesemaking processes
Identify bacteria by Gram stain status
Describe the purpose and result of a microbial disc assay
Explain what a microbiome is and how a disruption to a microbiome can be a problem
Explain an unintended consequence of antimicrobial use
Design an action plan based on experimental results
Apply knowledge of microbiome disruptions to a new scenario
Mule Case Study

Who’s The Daddy? by Ally Hunter

This is a story about a Texas farmer, Dale. Early one morning, farmer Dale is out feeding his animals, when he makes an amazing discovery. He enters his best mule Molly’s stall and finds a foal (baby equine) by her side. The foal is nursing from the mule, and Molly is tending to him like a good mother.

Farmer Dale is confused and calls the veterinarian. Dr. Lopez draws blood from the foal and Molly and sends it to the State Veterinary Lab in Texas for a karyotype.

Content Delivery

Interrupted Narrative:
Part I: Farmer Dale’s Surprise!
Part II: Farmer Dale calls the Vet
Part III: Who’s the Daddy?: Karyotypes return from the lab
Part IV: Wrap Up: Chromosome Affinity Hypothesis

Learning Outcome Activity:
What learning outcome or topic can you teach with this story?

Use the link in the chat to post your ideas or learning outcomes and topics on the Mule Jam Board.

Click the sticky note icon on the left to add an outcome/topic to the board.

Content Delivery

Interrupted Narrative:
Part I: Farmer Dale’s Surprise!
Part II: Farmer Dale calls the Vet
Part III: Who’s the Daddy?: Karyotypes return from the lab
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Learning Outcomes:
• Compare and contrast the two types of cell division
• Recognize key differences between mitosis and meiosis
• Define and explain karyotyping and interpret a karyotype
• Explain homology and demonstrate how it relates to mule sterility

Case Studies Can be Developed to Deliver Biology Content Through:

A robust narrative
• Story engages students
• Interrupted to scaffold and build knowledge
• Introduces content then works with content
• Contains open-ended questions for students to work with content and concepts

Using experimental data
• Introduce a procedure, technique, concept
• Learn laboratory skills and generate data (wet lab)
• Students engage with actual results
• Can analyze data and draw conclusions

Take Away

➢ What stories, scenarios, or dilemmas could be interesting for your students?
➢ What content could align with those stories?

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How do we ensure equitable small group during case studies?

Case Study Framework

- Real World Connection
- Understanding Biology

Role of the Narrative

Pedagogical Features

- Role of instructor
- Participatory environment

Transfer of Knowledge

Feelings of Inclusion

Situational Interest

Structuring Small Group Work for Prior Knowledge and Inclusion

Missing Microbe Questions

Part I: Sofia’s Bad Day

- What could have happened to Sofia’s cheese?
- How do different varieties of cheeses get their texture and flavor?
- What should Sofia do?

Small Group Work

Is a moderator of prior content knowledge
- Students maintain situational interest during the case study with or without prior content knowledge

Gives students opportunities to share and build on:
- Prior content knowledge and prior contextual knowledge
- Create moments for expert and novice role shifts
- Allows opportunities for formative assessment

Activity for Non-Major’s Biology

Allow students to become experts: Jigsaw
- Hand out “cheese profiles” for students to read
- Students become experts on their cheese
- Meet with other students and share knowledge
- Then, tackle case study discussion questions related to Sofia’s cheese

Jigsaw

1st group meeting: All students receive same reading/content (ex: 5 groups of 4 students), students become “experts” on their content

Groups shuffle: To contain one expert from each content area (ex: 4 groups of 5 students)

2nd group meeting: Experts share with novices

Larger class discussion: Instructor facilitates; students report out; clarify and prepare to move on to next part of case study
Activity for Major’s Biology/Microbiology

Students are assembled into teams of expert microbiologists. They are tasked to:

- Have a “brainwriting” session where all members contribute to answer each question before discussion.
- Then have a meeting to discuss all options and ideas.
- Come to a consensus and make predictions of what happened and a plan for next steps.

Brainwriting

- Different from brainstorming
- Idea generation exists separate from discussion
- All individuals write their ideas down on a sticky notes
- All sticky notes are put up
- THEN discussion begins

Deliberate Structuring of Small Group Work Can Create a More Inclusive Classroom

Jigsaw creates expert and novice role shifts
- Value and respect the perspective and contributions made by all students
- Creates a learning environment that welcomes participation
- Marginalized voices are seen and heard
- Dominant identities value and hold space for all perspectives

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Resources