COLLEGE OF Saint Benedict

Saint John's UNIVERSITY

# Are Students Achieving Higher Level Thinking in a upper level Biology course?

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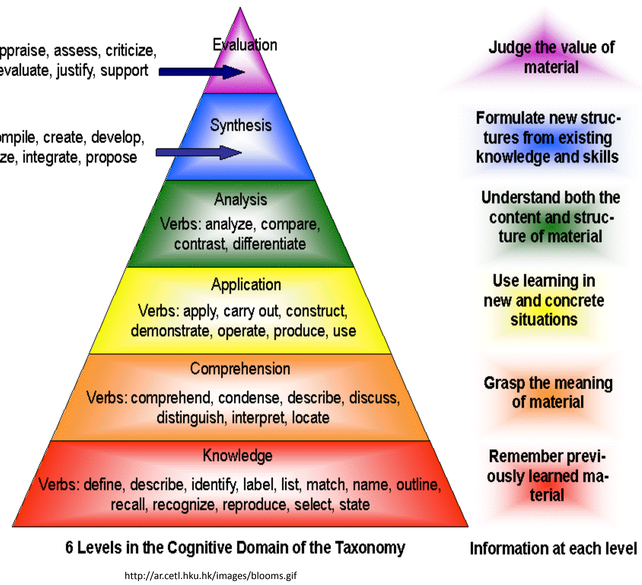
## What do we want our students to learn?

Upper level coursework in Biology is completed not only by Biology majors but other majors whose interest is a career in health. Microbiology (BIOL307) is a course required or recommended for many graduate schools including training to become a Physician Assistant, Physical Therapy, Dental school, as well as PhD programs in Microbiology and Immunology. Highlighted here are learning goals for students completing this upper-level Microbiology course. While a certain knowledge base is expected as students complete Microbiology, this knowledge base is continually expanding as technological advances and research continues. This means all content cannot be provided in a single semester. Thus, students must develop a capability to think and learn independently so when exposed to research information or new scientific concepts, they are able to process, understand and apply this material. Presented here are mechanisms to assess and help students reach these levels of higher level thinking while also providing comprehensive knowledge.

## At what level do we expect student learning?




**Can they apply and use these concepts to understand, develop and evaluate scientific research?**

**Do students have an understanding of the concepts?**

## What are the learning goals for a Microbiology course at these different levels of learning?

### Higher level thinking:

- Apply microbiology concepts to predict and evaluate the impact that microorganisms have in our everyday lives and on the planet. This will include their role in infectious disease, nutrient cycles, evolution, and ecosystem structure.
- Identify, practice and apply the basic process of science with the following:
  - Evaluate experimental data and apply this data to our understanding of microbiology.
  - Predict the outcome of scientific experimentation.
  - Design experiments to test your predictions.
  - Apply microbiology concepts to current issues.

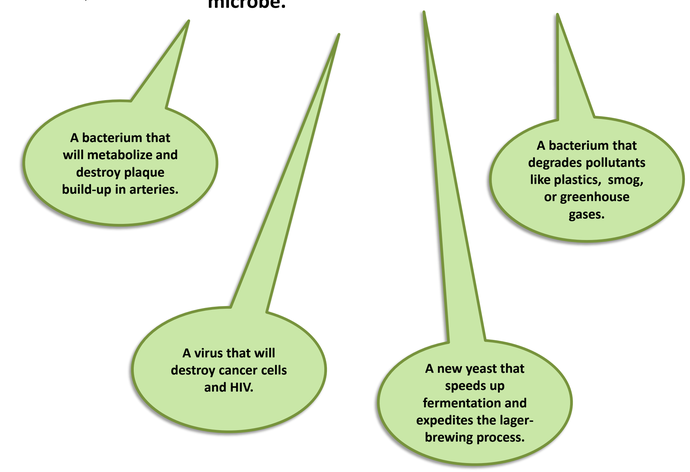
### Comprehension:

- Compare and contrast the different, major groups of microorganisms. How does their basic structure and cellular differences relate to their differences in function?
- Compare and contrast metabolic pathways that a microorganism and what this means for its survival in different environments?
- Describe the evolutionary process for a prokaryote. How does horizontal gene transfer impact its evolution? This includes the processes of reproduction and horizontal gene transfer.
- Identify and predict mechanisms for microbial control. How do antibiotics work?
- Identify and practice key research skills utilized in the field of microbiology.

## How do we assess learning in Microbiology?

### Higher-level thinking assessment:

**Hypothetically design a synthetic microbe that will impact humanity or the planet. Describe its physical, metabolic and genetic structure. Explain how its function will impact humans and the planet. Evaluate the ethical considerations in the design and use of this microbe.**




### Comprehension assessment:

### Formative assessment:

- **In class concept maps**
- **In class comparative tables**
- **In class application: scenarios that require content knowledge:**

**EXAMPLE OF AN IN-CLASS ASSIGNMENT:**
***Desulfurococcus mobilis:*** **This is an archaea that lacks a cell wall, but contains an S-layer. This S layer is thought to be somewhat flexible in nature to help in changes in salt concentrations in the environment. Its cell membrane is full of diethers (as shown below). Its optimal growth is at 85C and its major mechanism for ATP production is through sulfur reduction and can tolerate acidic conditions. It commonly uses sugars to be oxidized during ATP production.**

**Question 1: What are the survival requirements for this microbe?**
**Question 2: Draw this microbe's mechanism for ATP production.**
**Question 3: What environment might you expect this microbe to live in?**

### Summative assessment:

**Multiple choice and short answer exams/quizzes**