

BIG IDEAS:

- Infection and Methods of Destruction
- Mechanisms of pathogenesis
- Host-microbial relationships
 - o Medical microbiology
 - o Food microbiology
 - o Environmental microbiology
- Methods of controlling microbes
- Bioengineering and Careers

STAGE ONE: DESIRED RESULTS

ESTABLISHED GOALS

National Science Content Standard: Unifying Concepts and Processes

Conceptual and procedural themes unify science disciplines and provide students with powerful ideas to help them understand the natural world. (Evidence, Models, and Explanation)(Constancy, Change, and Measurement) (Form & Function)

National Science Content Standard: Science and Technology

As a result of their Pre-K-12 schooling, all students should develop abilities of technological design and understandings about science and technology.

Illinois Learning Standard 11.B: Know and apply the concepts, principles and processes of technological design.

Illinois Learning Standard 13.A: Know and apply the accepted practices of science.

Illinois Learning Standard 13.B: Know and apply concepts that describe the interaction between science, technology and society.

National Science Content Standard: History and Nature of Science

As a result of their Pre-K - 12 schooling, all students should develop understanding of: science as a human endeavor, the nature of scientific knowledge, and historical perspectives.

Illinois Learning Standard 13.A: Know and apply the accepted practices of science. (Validity)

Illinois Learning Standard 13.B: Know and apply concepts that describe the interaction between science, technology and society.

National Science Content Standard: Life Science – Form & Function and Interdependence

As a result of their Pre-K – 12 schooling, all students should develop an understanding of: the cell, the molecular basis of heredity, biological evolution, the interdependence of organisms, matter, energy, and organization in living systems, and the behavior of organisms.

Illinois Learning Standard 12.A: Know and apply concepts that explain how living things function, adapt and change.

Illinois Learning Standard 12.B: Know and apply concepts that describe how living things interact with each other and with their environment.

ESSENTIAL QUESTIONS

- How do the various mechanisms of pathogenesis operate?
- How do microbes negatively impact their environments?
- What are the differences in treating and controlling microbes?
- How does resistance to chemotherapeutic agents develop?
- How can developments in technology be used to control microorganisms?

ENDURING UNDERSTANDINGS

- Interactions between microbe and host may be for nourishment, reproduction, or protection. This interaction may be beneficial to the microbe and be harmful for the host.
- Natural selection leads to microorganisms that are well suited for survival in particular environments.
- Using evidence to understand interactions between microbes and their environment allows individuals to predict changes in natural and designed systems.
- Technological design is driven by the need to meet human needs and solve human problems. Technological solutions may create new problems, and may also challenge people's beliefs and practical explanations concerning various aspects of the world.
- Human activities can, deliberately or inadvertently, alter microbial equilibrium.
- The length and quality of human life is influenced by food quality, environmental quality, developments in technology, personal health behaviors, and infectious diseases.

CORE KNOWLEDGE

- While many microbes have vital roles in ecosystems and may provide useful products for humans, many microbes can cause disease.
- There are different methods of pathogenesis depending on the type of microorganism causing the infection.
- Bacteria can cause disease by destroying body tissues and some through producing toxins.
- Antibiotic resistance spreads when sensitive populations of bacteria are killed by antibiotics allowing resistant bacteria to thrive.
- Protists can form deadly blooms that negatively affect aquatic ecosystems.
- There are a number of protists that can cause significant disease in humans and other organisms.
- Fungi can cause disease by absorbing nutrients from host tissues and by producing toxins.
- It is difficult to develop a drug that destroys a virus without harming the living host organism because viruses reproduce inside host cells.
- Chemotherapeutic agents are developed to target specific structures within specific microbes.
- Emerging diseases are infectious diseases that have either recently spread or reemerged from a once considered isolated and maintained state.
- Vaccines are deactivated varieties or small particles of pathogens that are used to stimulate the immune system to defend against the actual

SCIENCE PROCESS SKILLS

- Demonstrate proper lab techniques.
- Evaluate advanced bioengineering techniques.
- Create scientific illustrations with proper labeling.
- Conduct valid scientific research in an area of microbiology.
- Debate the pros and cons of medical bioengineering procedures.
- Predict outcomes of specified case studies.

HABITS OF MIND

• **Values and Attitudes**

Honesty

Honesty is highly prized in the scientific community and essential to the scientific way of thinking and doing. In school there are numerous opportunities to show what honesty means and how it is valued.

Curiosity

By fostering student curiosity, teachers can help students uncover ways to find answers to questions about how the world works.

Openness to New Ideas

New ideas are essential for the growth of science. Science education should help all students understand the great importance of carefully considering ideas that at first may seem troublesome to them or at odds with what they generally believe.

pathogen.

ESSENTIAL VOCABULARY

Pathogenesis

Pathogen

Pathology

Opportunistic pathogen

Virulence

Virulence factors

Toxin

Endospore

Phagocytosis

Pinocytosis

Host

Vector

Reservoir

Fomite

Carrier

Mutation

Sepsis

Infection

Systemic infection

Localized infection

Focal infection

Mixed infection

Adhesion

Infection

Inflammation

Epidemic

Pandemic

Mortality

Morbidity

Emerging

Lytic cycle

Lysogenic cycle

Spoilage

(Thermophilic anaerobic, Flat sour, Putrefactive anaerobic)

Thermophilic bacteria

Mesophilic bacteria

Pollution

Algal bloom

Eutrophication

Detrimental

Dermatophyte

Protozoan

Vaccine

Antigen

Immunity

Herd immunity

Antibody

Hypersensitivity

Allergens

Informed Skepticism

Science is characterized as much by skepticism as by openness. Science education can help students see the social value of systematic skepticism and develop a healthy balance in their own minds between openness and skepticism.

- **Computation and Estimation**

Science literacy includes being able to use computational tools thoughtfully and with confidence. The teaching of science should include problem solving that emerges from student activities and the content being studied. It requires students to make calculations and check their answers against their estimates and their knowledge of the problem.

- **Manipulation and Observation**

Education for science literacy implies that students develop the habit of using tools to solve practical problems and to increase their understanding of how the world works. Tools, from hammers and notebooks to cameras and computers, extend human capabilities.

- **Communication**

Discourse in science calls for the ability to communicate ideas and share information with fidelity and clarity, and to read and listen with understanding.

- **Critical Response Skills**

In various forms, the mass media, teachers, and peers inundate students with assertions, arguments, and claims about all kinds of things. Science education should prepare people to read or listen to such assertions critically, deciding what evidence to pay attention to and what to dismiss. Furthermore, people should be able to apply those same critical skills to their own observations, arguments, and conclusions, thereby becoming less bound by their own prejudices and rationalizations. These critical response skills can be learned, and with practice, can become a lifelong habit of mind. Critical response skills include, but may not be limited to: questioning the reliability of data; questioning sources of information for validity and bias; making sure scientific methods are reliable, consistent and reproducible; recognizing multiple points of view; and recognizing that scientific understanding is a matter of interpretation.

Drug Resistance

MISCONCEPTIONS

- Ringworm infections are caused by a worm.
- Antibiotics can treat any infection.
- Viruses can be treated with antibiotics.
- Fungal infections can be treated with antibiotics.
- Disinfectants and hand sanitizers kill everything.
- Some vaccines are harmful. (autism)
- Chemotherapy only treats cancer.

APPLICATIONS OF LEARNING

- **Solving Problems** - Recognize and investigate problems; formulate and propose solutions supported by reason and evidence.
- **Communicating** - Express and interpret information and ideas.
- **Using Technology** - Use appropriate instruments, electronic equipment, computers and networks to access information, process ideas and communicate results.
- **Working on Teams** - Learn and contribute productively as individuals and as members of groups.
- **Making Connections** - Recognize and apply connections of important information and ideas within and among learning areas.

STAGE TWO: DETERMINE ACCEPTABLE EVIDENCE

FORMATIVE ASSESSMENTS

Laboratories and Activities

Lab/activities

Antibiotic resistance sensitivity discs
 Replica plating
 Properties of disinfectants
 Microbes and household disinfectants and/or drugs
 Antibiotic resistant plasmids
 Effects of premature termination of antibiotic treatment
 Growth curve for bacteriophages
 Bacteria in Meat
 Transmission of infection
 Pollution—the overabundance of nutrients
 Is bleach a good disinfectant lab?
 Mold Growth (and amt of preservatives?)

Journal/Reflections

Daily journal readings and reflections

- How is it possible for children and men to get yeast infections?
- Why is it not possible to get warts from picking up a toad?
- Why is it important to keep up to date with vaccinations?
- Why is it important to take the full course of medication?
- Why is it not beneficial to take antibiotics to treat a viral infection?

Epidemiologic case studies

FM CS #4: An Introduction to the Prokaryotic Cells, Its Organization, and Members

- Immune response
- How use of vaccines can reduce the spread of disease

FM CS #5: Eukaryotic Cells and Microbiology

- Cysts
- Cyst formation and resistance to disinfectants
- Control of eukaryotic infections

FM CS #6: An Introduction to Viruses

- How are antibiotics are ineffective against viruses.
- How viruses are spread in populations and how the *type* of population impacts the extent of the spread.

FM CS #8: An Introduction to Microbial Metabolism: The Chemical Crossroads of Life

- The consequences of prolonged antibiotic treatment.

FM CS #9: Microbial Genetics

How mutations arise and how random changes in DNA can confer unexpected

- Phenotypic changes.
- The transfer of genes between species.
- How environmental conditions, such as the use of antibiotics, can select for survival cells carrying a specific trait.

FM CS #12: Drugs, Microbes, Host – The Elements of Chemotherapy

- The use of multi-drug therapy to combat the development of resistance.

FM CS #27: Applied and Industrial Microbiology

- Epidemiology of infection disease.
- The limits of traditional microbiological techniques.
- The use of genetic fingerprinting to characterize bacterial species.

SUMMATIVE ASSESSMENTS

Performance Tasks	Other Evidence
Lab practical Case study Vaccine shortage implications	<ul style="list-style-type: none">• District common assessment

STAGE THREE: LEARNING PLAN

Mechanisms of pathogenesis

Explain the various mechanisms of pathogenesis of bacteria.

Explain the various mechanisms of pathogenesis of protists.

Explain the various mechanisms of pathogenesis of fungi.

Explain the various mechanisms of pathogenesis of viruses.

Host-microbial relationships - Medical microbiology

Describe how bacteria cause disease by destroying body tissues and some through producing toxins.

Explain how opportunistic pathogens cause infections.

Explain the process of acquiring antibiotic resistance.

Predict the potential consequences of resistance to chemotherapeutic drugs.

Identify microbes that can cause significant disease in humans and other organisms.

Describe how fungi cause disease by absorbing nutrients from host tissues and by producing toxins.

Explain the difficulty in developing a drug that destroys a virus.

Host-microbial relationships - Food microbiology

Describe how fungi cause disease by absorbing nutrients from host tissues and by producing toxins.

Predict the outcome of poor food preparation and storage practices.

Host-microbial relationships - Environmental microbiology

Describe the affects of deadly algal blooms.

Describe how fungi cause disease by absorbing nutrients from host tissues and by producing toxins.

Methods of controlling microbes

Explain the targets of specific chemotherapy agents.

Describe tests for microbial susceptibility to chemotherapeutic agents.

Predict the impact of emerging microbial diseases.

Illustrate how a vaccine works to develop immunity to a specific microbe.

Compare and contrast methods of controlling microbe populations.

Bioengineering and Careers

Illustrate how a chemotherapeutic agent and/or vaccine is developed.

Recognize and debate the ethical implications surrounding medical research and drug development and testing.