

TELLING BIOLOGY TEACHER'S GUIDE



STANDARDS:

The following standards may be addressed by using the podcast in conjunction with the information provided in the Teacher's Guide:

NGSS

HS-LS4-4.

Construct an explanation based on evidence for how natural selection leads to the adaptation of populations

HS-LS4-5(1).

Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) the increase in the number of individuals of some species.

GPS

SMI7(b-C). Students will analyze symbiotic and pathogenic relationships in host-microbe interactions.

b. Describe examples of pathogenic microorganisms and how they cause disease in plants and animals.

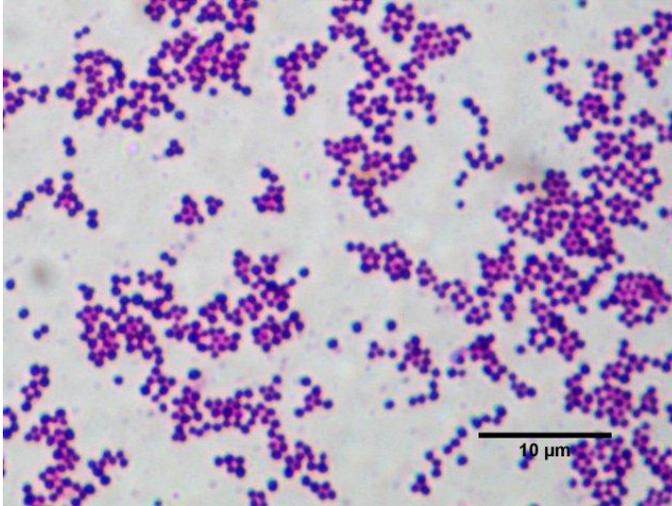
c. Compare mechanisms of how communicable diseases are spread among individuals within a population and how genetic changes in pathogenic microbes (such as influenza virus) result in new outbreaks of disease

Background

This is a story to help get student excited about science by introducing them to the subject of microbial evolution and antibacterial resistance in pathogenic bacteria.

Staphylococcus aureus

S. aureus is a gram positive coccal bacterium, meaning that it is a prokaryotic organism that has a thick cell wall composed mainly of peptidoglycan which generally has a round circular shape (cocci). This organism is a facultative anaerobe, which means that it can do aerobic respiration in the presence of oxygen, but will switch to anaerobic fermentation in the absence of oxygen.



This is a view of *S. aureus* under 1000x magnification using a light microscope and the typical Gram stain test.

<http://cit.vfu.cz/alimentarni-onemocneni/xsa/xsa01.html>

Impact of MRSA (Methicillin Resistant Staphylococcus aureus)

Staphylococcus aureus is a common cause of healthcare-associated infections, and 86% of all invasive MRSA infections are healthcare-associated.

- MRSA has become one of the most common and serious pathogens in healthcare-associated infections (nosocomial).
- Treatment options for MRSA are limited and less effective than options available for susceptible *S. aureus* infections, and they usually result in higher much higher morbidity and mortality rate.
- High prevalence influences unfavorable antibiotic prescribing, which contributes to further spread of resistance.

Pathogenesis

- Colonization generally precedes infection with most cases of MRSA infection.
- Colonization can be long-lasting, as once acquired an MRSA infection can last months or years with multiple periods of remission.
- MRSA is generally transmitted from person to person, though environmental infections do occur.
- the spontaneous generation of resistance in *S. aureus* is very rare

Prevention

- Prevention generally focuses on two major areas
 - Preventing transmission from infected to non-infected individuals through isolation and BSA (Body Substance Isolation), hand washing, and surface and object sterilization.
 - Preventing active infections in individuals colonized by MRSA through monitoring.

Academic Language

- **Prokaryote:** A single celled organism that lacks a nucleus or membrane bound organelles.
- **Gram Positive:** bacteria that give a positive result in the Gram stain test.
- **Peptidoglycan:** The primary component of bacterial cell walls that consists of a polymer containing sugars and amino acids that forms a mesh-like layer outside the plasma membrane.
- **Nosocomial:** An infection acquired within a hospital or other health care facility
- **Pathogenesis:** The biological mechanism by which a disease organism infects a new host.
- **Infection:** the invasion of host tissues by disease causing infectious agents
- **Colonization:** The presence and multiplication of a microorganism without tissue invasion or damage.
- **Antibacterial Resistance:** The resistance of a microbe to one or more antimicrobial agents used to treat infection.
- **Respiration (cellular):** The set of metabolic reactions and processes that take place within the cell to generate energy.
- **Aerobic:** Requiring or utilizing oxygen
- **Anaerobic:** Not requiring or utilizing oxygen
- **Fermentation:** A metabolic process that converts sugars into acids, gases, or alcohols under anaerobic conditions.

Things to Think About

1. *S. aureus* is a Gram-positive bacterium, what are its characteristics and defining features?
2. What are the defining features of a Gram-negative bacteria, and how does it differ from a Gram positive?
3. If MRSA is resistant to Methicillin antibiotics, what can be used to treat infections caused by it?
4. What is the most common way to prevent the transmission of MRSA from one person to another, and what does BSA mean and entail?
5. What is VRSA and how does it differ from MRSA?

References

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