

Name: _____ Date: _____ Sec: _____

Worksheet - Lesson 4.3

Learning objectives. At the end of today's lesson you will be able to:

- name adaptations and explain how they benefit bacteria in the right environments.
 - describe how adaptations are used to gain access to nutrients.
 - discuss the limits to acquiring adaptations.
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Do now:

What do microbes need in order to become pathogenic?

What *adaptations* might a microbe need to become pathogenic?

Activity:

Assigned niche/habitat:

Which adaptations do you think will be the MOST important for the survival in your habitat?
Explain why.

The team with the best overall adaptations for their environment will win the game. Which adaptations might you want to keep away from the other teams? Explain why.

After the auction is over:

1. Name your bacterium (Genus and species, e.g. *Staphylococcus* (genus) *aureus* (species)).
2. Describe your bacterium's niche.
3. Draw your bacterium. Include and label the adaptations you bid on/wanted, not just the ones you got.
4. Explain why your adaptations will help your bacterium survive and reproduce in its habitat (1 paragraph).

Adaptations: Each team has \$1,000 to bid with!!!

1. **Gram-positive bacteria** – have thick cell walls that contain multiple layers of a sugar-peptide polymer called murein, which is a rigid molecule. Many Gram-positive bacteria can withstand high salt in the skin.
2. **Gram-negative bacteria** – have cell walls with thin murein layers, but which contain an additional outer membrane. The outer membrane has LPS, an endotoxin that causes inflammation. Gram-negative bacteria are also more resistant to bile salts in the gastrointestinal (GI) tract.
3. **Acid-fast bacteria** – have cell walls that also contain large amounts of waxes as well as murein. The cell walls allow the bacteria to resist the chemical barriers of the immune system.
4. **Low replication rates** – help infection persist for long periods of time because the bacteria don't activate the immune system.
5. **High replication rates** – allow bacteria to spread quickly within the host.
6. **Flagellum** – allows bacteria to travel to find nutrition.
7. **Spore formation** – allows some Gram-positive bacteria to survive when nutrients are depleted.
8. **Capsule** – provides perfect camouflage from the immune system.
9. **Extracellular replication** – allows bacteria to spread rapidly. They may survive and spread on the body's surfaces and even on inanimate objects.
10. **Intracellular replication** – allows bacteria access to the nutrients they need from inside host cells and also to hide from (evade) immune cells.
11. **Produces exotoxins** – bacteria produce a molecule that kills host cells, allowing them to spread into deeper tissues.
12. **Produces endotoxins** – bacteria produce a molecule that causes inflammation, helping them spread into deeper tissues via the blood stream.
13. **Produces exoenzymes** – bacteria produce an enzyme that breaks down the connections (matrix) surrounding host cells. For example, some exoenzymes can digest blood clots and help the bacteria invade wounds. This allows them to spread into deeper tissues.

Body niche:	Lungs	Intestines	Intestines	Skin	Nose Lungs	Genital epithelium	Blood	Blood Brain
Diseases examples:	TB	Cholera	Gastro-enteritis	Skin infection	Pneumonia	Chlamydia	Tetanus	Meningitis
Pathogen	<i>Mycobacterium tuberculosis</i>	<i>Vibrio cholerae</i>	<i>Escherichia coli</i>	<i>Staphylococcus aureus</i>	<i>Streptococcus pneumoniae</i>	<i>Chlamydia trachomatis</i>	<i>Clostridium tetani</i>	<i>Neisseria meningitidis</i>
Gram (+)				(+)	(+)	(-)	(+)	
Gram (-)	Acid-fast	(-)	(-)					(-)
Acid-fast								
Intracellular	Intra	Extra	Extra	Extra	Extra	Intra	Extra	Extra
Extracellular		Fast	Fast	Fast	Fast	Slow	Fast	Fast
Replication	Slow							
Toxin production		Exotoxin	Exotoxin Endotoxin	Exotoxins Exoenzymes	Exoenzymes		Exotoxin	Endotoxin
Spore forming							Yes	