Antibiotic Resistance A Closer Look at Bacteria and the Microbiome

Presentation for Grade 8 Students





Today we will learn:

- 1) The differences between **bacteria and viruses**, and their role in health and illness
- 2) How **antibiotic resistance** develops and why it's a problem
- 3) How we can **prevent** the spread of infections

How YOU can prevent the spread of superbugs!

A Look Inside Our Microbiome



Your body contains 10-100 trillion micro-organisms!

This can include:

- Helpful bacteria \rightarrow commensals
 - Help in digestion and nutrient absorption
 - Compete with bad bacteria and protect you from infection
- Harmful bacteria → pathogens
- Viruses that can also be harmful

A Look Inside Our Microbiome

Viruses and bacteria can both cause illness in humans, but they are very different.



Bacteria and Viruses

Antibiotic Resistance

A Look Inside Our Microbiome





Bacteria and Viruses

Antibiotic Resistance

Activity 1: What are similarities and differences between bacteria and viruses?



Bacteria and Viruses

Antibiotic Resistance

Illnesses caused by viruses	Illnesses caused by bacteria
→ Common cold	→ Strep throat
→ Influenza (flu)	→ Tuberculosis
→ Chicken pox	\rightarrow Urinary tract infections (UTIs)
→HPV	→ Salmonella
\rightarrow Most sore throats	\rightarrow Pertussis
→ COVID-19	→ Meningitis

What are antibiotics?



- Medicines that are used to treat illnesses caused by **bacteria**.
- Antibiotics are designed to attack the **unique** structures and machinery of bacterial cells.
- Viruses are non-cellular, and have **different** structures and machinery than bacteria, so antibiotics cannot kill them.

Illnesses caused by viruses	Illnesses caused by bacteria
→ Common cold	→ Strep throat
→ Influenza (flu)	→ Tuberculosis
→ Laryngitis	\rightarrow Urinary tract infections (UTIs)
→ Chest colds (bronchitis)	\rightarrow Some types of pneumonia
\rightarrow Most sore throats	\rightarrow Pertussis
Do NOT use antibiotics	→ Meningitis Can use antibiotics

What are the harms of using antibiotics when we don't need them?

Overuse of antibiotics can lead to **antibiotic resistance**

(Optional) Watch this video on antibiotic resistance:

youtu.be/qDluMg9lqn8

Bacteria and Viruses



Bacteria mutate **at random.**

Bacteria and Viruses

Antibiotic Resistance



Bacteria mutate **at random.**

Some bacteria can happen to develop a mutation that makes them **resistant** to antibiotics.

Bacteria and Viruses

Antibiotic Resistance



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Some bacteria can happen to develop a mutation that makes them **resistant** to antibiotics. Normally, **good bacteria** take up space in our body and prevent any **resistant** bacteria from taking over.

Bacteria and Viruses

Antibiotic Resistance



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When we use antibiotics, we **kill** susceptible (nonresistant) bacteria, but the **resistant bacteria survive**.



Bacteria mutate **at random.**

Some bacteria can happen to develop a mutation that makes them **resistant** to antibiotics. Normally, good bacteria take up space in our body and prevent any resistant bacteria

from taking over.





When we use antibiotics, we **kill** susceptible (nonresistant) bacteria, but the **resistant bacteria survive**. The **resistant bacteria** now have lots of space to **grow and flourish.**

This is **natural selection in action!**

Bacteria and Viruses

Antibiotic Resistance

Activity 2



Terry is feeling sick. He found some antibiotics in his medicine cabinet. What could happen if:

- Terry took the leftover antibiotics and his illness was actually caused by a **virus**?
- Terry took the leftover antibiotics and his illness was actually caused by **bacteria**?
- Terry went to the doctor who gave him antibiotics to take?

Think about **good bacteria**, **bad bacteria**, and the risk of **antibiotic resistance** in each case

How does antibiotic resistance spread?





Resistant bacteria can transfer their resistant gene to other bacteria through **conjugation**

Bacteria and Viruses

How does antibiotic resistance spread?



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Bacteria and Viruses

How does antibiotic resistance spread?

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Resistant bacteria can transfer their resistant gene to other bacteria through **conjugation**



Spread from person to person

Why is antibiotic resistance a problem?

The spread of antibiotic resistance means that the drugs that we normally use to treat infections **no longer work**.

Antibiotics are **life-saving treatment** in many situations:



Bacteria and Viruses

Antibiotic Resistance

How can we stop the spread of antibiotic resistance?



Every time we use antibiotics, we provide a **selection pressure** for bacteria to develop resistance.

It's our job to limit our use of antibiotics, so that they work when we really need them.

This way, we can **preserve antibiotics** now and for the future



Bacteria and Viruses

Antibiotic Resistance



Antibiotic Resistance

Prevent infections – if you don't get sick, you don't need antibiotics! When we **do** get sick, only use antibiotics if we need to – ask your doctor!







Bacteria and Viruses

Antibiotic Resistance



Bacteria and Viruses

Antibiotic Resistance



Bacteria and Viruses

Antibiotic Resistance

- → Prevent infections if you don't get sick, you don't need antibiotics!
- \rightarrow When we **do** get sick, only use antibiotics if we need to

Activity 3: Group Brainstorm

How can we prevent infections?

Bacteria and Viruses

Antibiotic Resistance

How can we prevent infections?

- Handwashing
- Stay home if sick
- Stay up to date on vaccinations
- Use antibiotics wisely

How can we prevent infections?

- Handwashing
- Stay home if sick, physical distance, masks
- Stay up to date on vaccinations
- Use antibiotics wisely



Handwashing

 80% of common infections are spread by hands

Bacteria and Viruses

Antibiotic Resistance

Always dry your hands after washing!



- Removes 42% more germs than washing alone
- Wet hands transmit germs more easily than dry hands
- Some hot air dryers encourage bacterial growth because hands are left warm and moist
- Use clean towels

Handwashing – soap vs. sanitizer?

Plain soap and water

- Gets rid of bad bacteria and viruses
- Good bacteria are not easily removed by handwashing
- Need to dry hands!



- No water required
- Less drying time
- Does not cause antibiotic resistance
- Alcohol content should be over 60%
- Not effective if hands greasy or dirty
- Will kill good bacteria too

Avoiding antibacterial agents

- Alcohol-based sanitizers and plain soap do not cause resistance
- Some sanitizers and soaps have antibacterial agents:
 - Triclosan
 - **Quarternary ammonium compounds or "Quats"** end in "nium" ex. Benzalkonium chloride, benzylammonium chloride
- Can promote resistance
- Can also remove good bacteria

Hand Hygiene - what to choose?

- ✓ Regular soap
- Alcohol based sanitizers
- 🗴 Triclosan
- Quaternary ammonium compounds (Quats)

Avoid "antibacterial" soaps and sanitizers

Antibacterial hand soap

ANTIBACTERIAL HAND SOAP



Avoid contact with eyes. In case of contact, flush with water.

Ingredients: Aqua (Water), Sodium Lauryl Sulfate, Sodium Laureth Sulfate, Cocamidopropyl Betaine, Sodium Chloride, Cocamide MEA, Disodium Cocamido MIPA-Sulfosuccinate, Polyquaternium-7, Sorbitol, Glycerin, Propylene Glycol, Panthenol, Tocopherol Acetate, Fragrance, Triclosan, Cucumis Sativus (Cucumber) Fruit Extract, Equisetum Hiemale Extract, Salvia Officinalis (Sage) Leaf Extract, Thymus Vulgaris (Thyme) Extract, DMDM Hydantoin, Disodium EDTA.

Bacteria and Viruses

Antibiotic Resistance

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Triclosan

Bacteria and Viruses

Antibiotic Resistance

Quat

Plain soap

Foaming Hand Soap

With Vitamin E + Aloe Naturally derived Triclosan-free INGREDIENTS: AQUA (WATER), SODIUM LAURYL SULFATE, COCAMIDE DEA, COCAMIDOPROPYL BETAINE, GLYCERIN, ALOE BARBADENSIS GEL, TOCOPHERYL ACETATE (VITAMIN E), CITRIC ACID, SODIUM CHLORIDE, SODIUM CITRATE, BENZOPHENONE-4, METHYLCHLORO-ISOTHIAZOLINONE, METHYLISO-THISZOLINONE, PARFUM (FRAGRANCE), EXT. VIOLET 2.

Bacteria and Viruses

Antibiotic Resistance

Plain soap



No Quats

INGREDIENTS: AQUA (WATER), SODIUM LAURYL SULFATE, COCAMIDE DEA, COCAMIDOPROPYL BETAINE, GLYCERIN, ALOE BARBADENSIS GEL, TOCOPHERYL ACETATE (VITAMIN E), CITRIC ACID, SODIUM CHLORIDE, SODIUM CITRATE, BENZOPHENONE-4, METHYLCHLORO-ISOTHIAZOLINONE, METHYLISO-THISZOLINONE, PARFUM (FRAGRANCE), EXT. VIOLET 2.

Bacteria and Viruses

Antibiotic Resistance

Alcohol based hand sanitizer



ACTIVE INGREDIENT: Denatured ethanol 62% w/w OTHER INGREDIENTS: Aqua, Oleth-20, Carbomer, Parfum, Aminomethylpropanol, Aloe Barbadensis Leaf Extract

Bacteria and Viruses

Antibiotic Resistance

Alcohol based hand sanitizer



ACTIVE INGREDIENT: Denatured ethanol 62% w/w OTHER INGREDIENTS: Aqua, Oleth-20, Carbomer, Parfum, Aminomethylpropanol, Aloe Barbadensis Leaf Extract

Make sure the hand sanitizer does not contain triclosan or quats. Some alcohol based hand sanitizers do.

Bacteria and Viruses

Antibacterial toothpaste





Bacteria and Viruses

Antibiotic Resistance

Antibacterial toothpaste



		Toothpaste	
CAVITIES PLAQUE Sodium Fluoride 0.243%	BAD BREATH GINGIVITIS	✓ TARTAR BUILD-UP	
		Triclosan	

Regular toothpaste should have no triclosan in the ingredients.

Bacteria and Viruses

Antibiotic Resistance

How can we prevent infections?

- Handwashing
- Stay home if sick, physical distance, masks
- Stay up to date on vaccinations
- Use antibiotics wisely



Your immune system can **learn –** once you've been infected by a pathogen, it remembers how to destroy it

Bacteria and Viruses

Antibiotic Resistance



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Bacteria and Viruses

Antibiotic Resistance



Your immune system can **learn –** once you've been infected by a pathogen, it remembers how to destroy it

Bacteria and Viruses

Antibiotic Resistance





The next time you're exposed to that pathogen, your immune system can quickly destroy it before you get sick

Your immune system can **learn –** once you've been infected by a pathogen, it remembers how to destroy it

Bacteria and Viruses

Antibiotic Resistance

Vaccines contain an inactive pathogen or part of a pathogen



Bacteria and Viruses

Antibiotic Resistance

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Bacteria and Viruses

Antibiotic Resistance

Vaccines contain an inactive pathogen or part of a pathogen Vaccines help your immune system **learn** without having to get sick first.





If you get exposed, your immune system is ready to protect you

Bacteria and Viruses

Antibiotic Resistance

Vaccines contain an inactive pathogen or part of a pathogen Vaccines help your immune system **learn** without having to get sick first.





If you get exposed, your immune system is ready to protect you

Bacteria and Viruses

Antibiotic Resistance



- There are vaccines that prevent bacterial infections, such as pneumonia and meningitis
- Other vaccines prevent against viral infections (ex. HPV, COVID-19)
- Routine vaccinations are given in **Grade 9**

How can we prevent infections?

- Handwashing
- Stay home if sick, physical distance, masks
- Stay up to date on vaccinations
- Use antibiotics wisely

Let's return to Terry



Terry takes the antibiotics that his doctor prescribed him. His doctor told him to take the antibiotics for 10 days.

After 5 days of taking the antibiotics, Terry starts to feel better.

Should Terry stop taking the antibiotics? Why or why not?

What we learned today

- 1) That **bacteria and viruses are different**. They both can cause illness but only bacterial illnesses can be treated with antibiotics
- 2) Use **antibiotics wisely**. Bacteria can become resistant to antibiotics, so ask your doctor how to appropriately use antibiotics when they are prescribed to you
- 3) By **preventing illness**, we can minimize antibiotic use and stop the spread of superbugs

Questions?



Thank you!



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