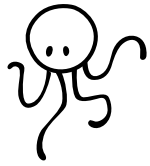
MICROBES

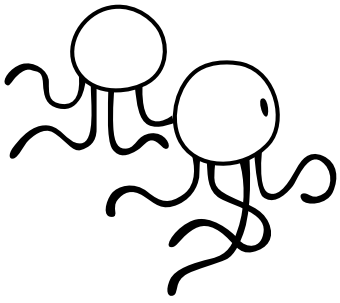
The Good, the Bad, the Ugly

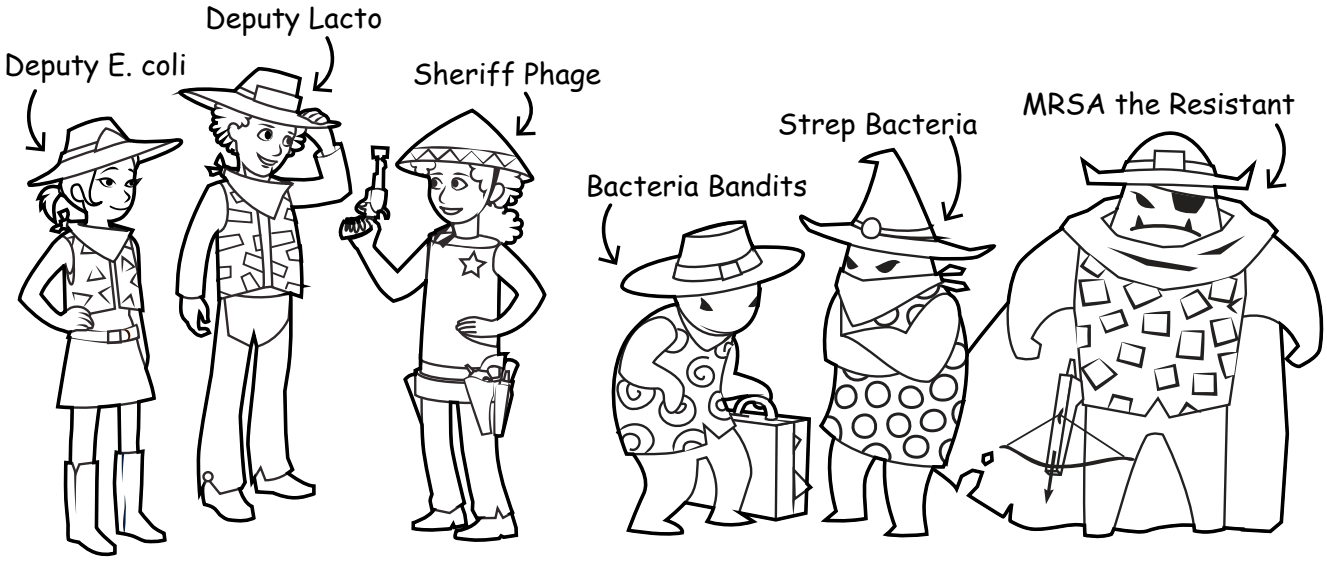
THERE'S MORE!



Get the whole story behind the Microbes comic book online at askabiologist.asu.edu/microbes

Or, learn more about your body's immune system in Viral Attack at askabiologist.asu.edu/viral-attack





Prologue

You may already know that some bacteria can make you sick. Unlike the bacteria that cause diseases and infections, most of the bacteria inside you right now are harmless and live peacefully side by side with the cells of your body. These bacteria work together with your cells to keep other unwanted invaders away and to help keep your body running smoothly.

Cast

In this story, you will see how good bacteria, antibiotics, and new technologies help keep the bad guys from taking over the body. Many bacteria appear throughout this story. They come in many different colors, shapes, and sizes.

Credits

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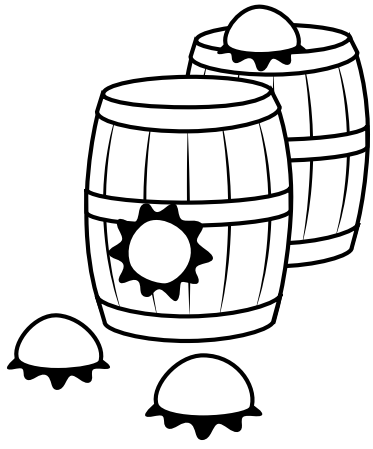


Our story takes place in the tiny hidden world inside your body...

You might not realize it, but you are home to **trillions** of bacteria, tiny life forms too small to see without the help of a microscope.

Bacteria come here from many different places.

Some float through the air in tiny particles of water.

ACHOO!

Others hitch a ride down the digestive system with the food you eat.

Some hop from person to person through the objects we touch, like money or door knobs.

Some kinds have lived here since the very beginning, when your body was just a couple days old.

Z

Many others (between 300 and 1,000 different kinds) have moved in since.

Human Body
Population:
10 Quintillion

Thriving bacterial communities exist in many different parts of the body.

Some live on the surface of your skin and on the hairs of your scalp.

Others make themselves at home in the plaque inside your mouth.

Little colonies even exist under your eyelids, on the surface of your eyes.

Your body's largest bacterial communities exist along your digestive tract, in your large and small intestines.

You might know it by another name: **your gut**.

Most folks in this town are good, helpful, law-abiding bacteria.

Hello!

Howdy!

How are you?

Need a hand?

They help with digestion and make important vitamins the body needs.

Vitamin K keeps blood and bones healthy.

Vitamin K

Biotin helps cell growth.

Biotin

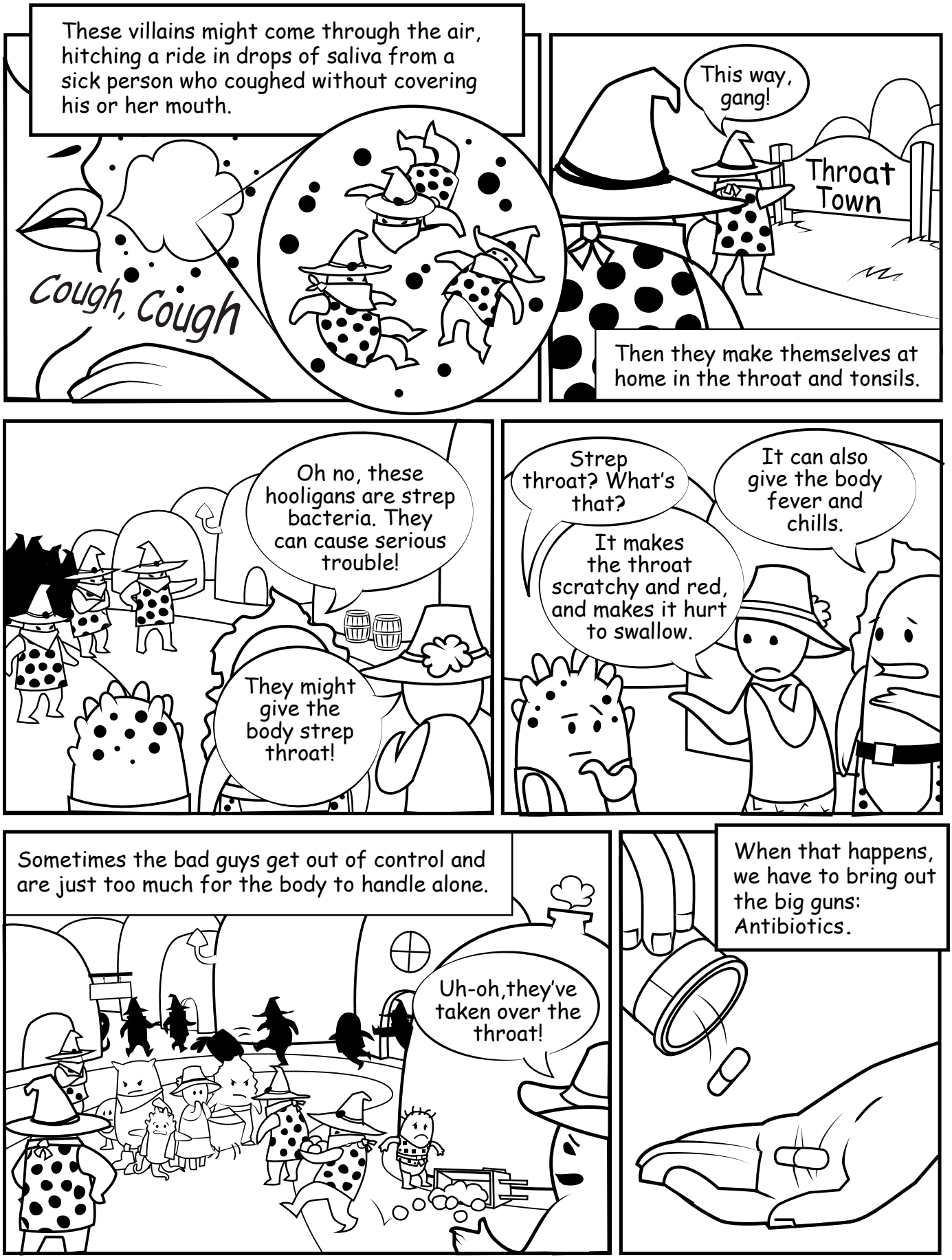
Hmmm...

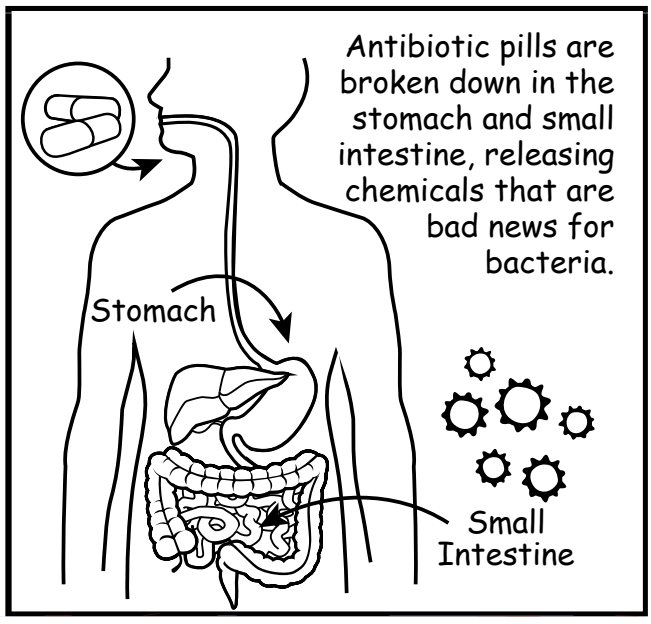
This place looks nice!

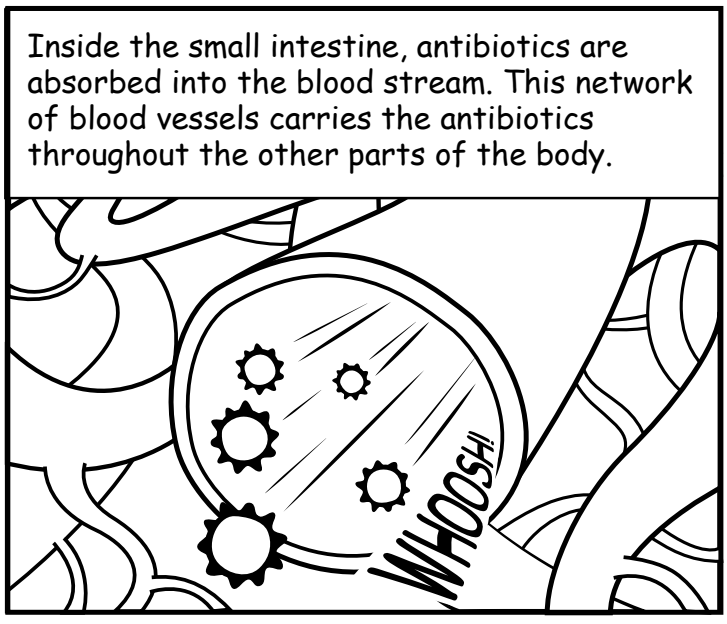
Gutville

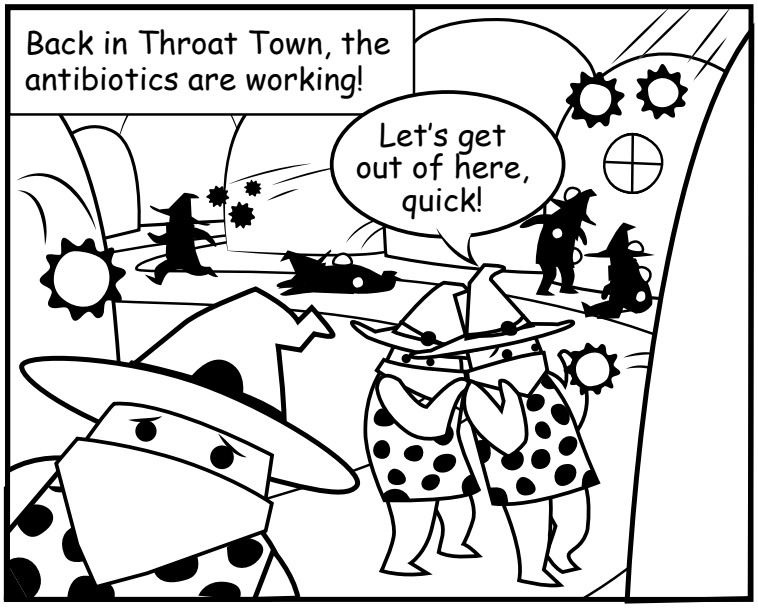
Once in a while, some pretty unsavory characters come to visit...

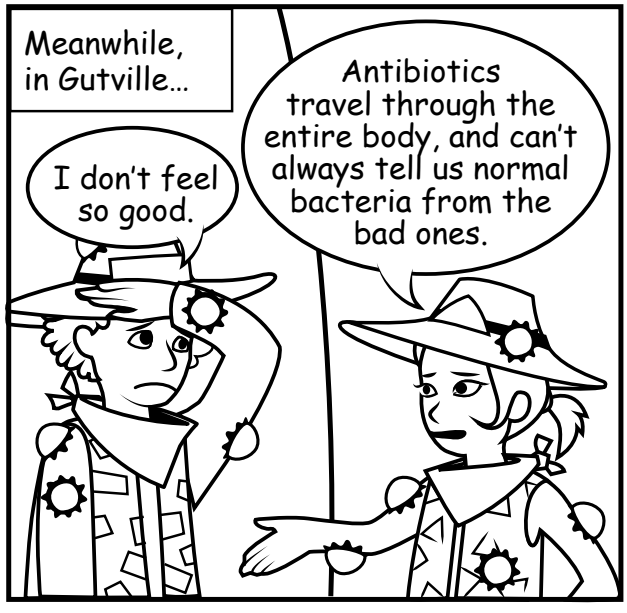

Let's meet the heroes of our town. When bad bacteria come to visit, it's up to these deputies to keep bad guys from making themselves at home.
How about that one?
Looks like we found our new home!
Howdy, I'm deputy Lacto.
Meet my partner, deputy E. coli.
So, what brings you to Gutville?
Woah, you don't belong here.
We're looking for a place to stay.
There's no room here for you folks.
Move along now!
EXIT
Usually, the body's defenses can keep the bad bacteria from sticking around.
Good job, partner!
Other unwelcomed visitors aren't quite so easy to get rid of...

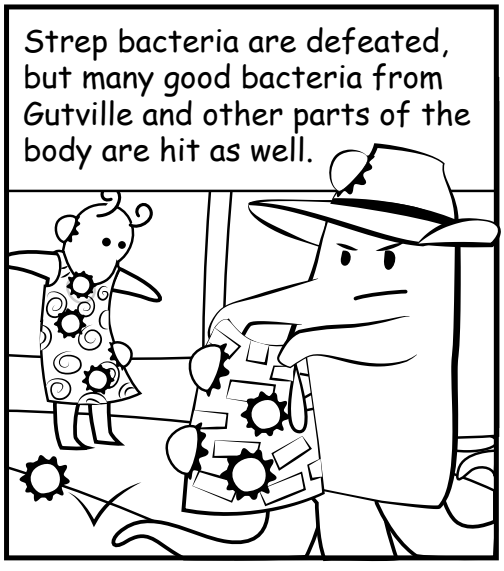

These villains might come through the air, hitching a ride in drops of saliva from a sick person who coughed without covering his or her mouth.
Cough, Cough
This way, gang!
Throat Town
Then they make themselves at home in the throat and tonsils.
Oh no, these hooligans are strep bacteria. They can cause serious trouble!
They might give the body strep throat!
Strep throat? What's that?
It makes the throat scratchy and red, and makes it hurt to swallow.
It can also give the body fever and chills.
Sometimes the bad guys get out of control and are just too much for the body to handle alone.
Uh-oh,they've taken over the throat!
When that happens, we have to bring out the big guns: Antibiotics.

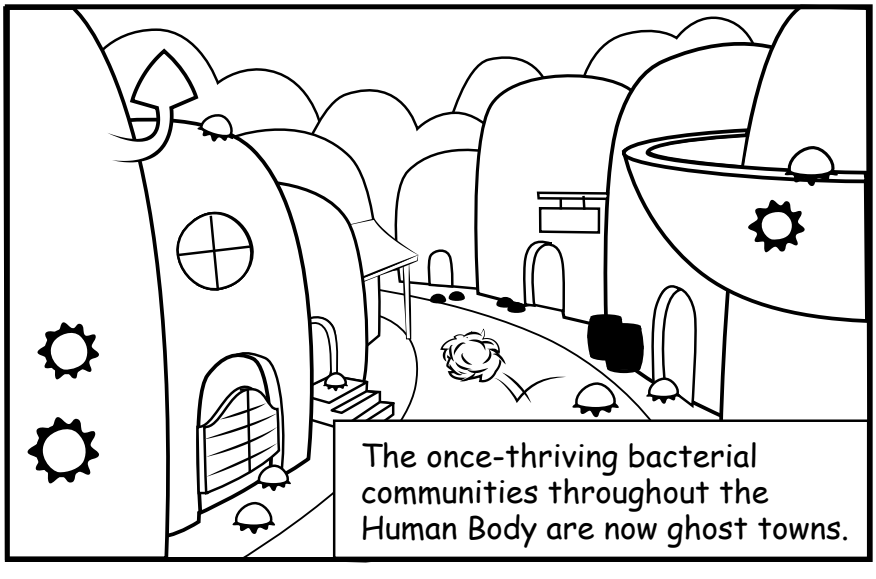

Antibiotic pills are broken down in the stomach and small intestine, releasing chemicals that are bad news for bacteria.
Stomach
Small Intestine


Inside the small intestine, antibiotics are absorbed into the blood stream. This network of blood vessels carries the antibiotics throughout the other parts of the body.
WHOOSH!


Back in Throat Town, the antibiotics are working!
Let's get out of here, quick!


Meanwhile, in Gutville...
I don't feel so good.
Antibiotics travel through the entire body, and can't always tell us normal bacteria from the bad ones.


Strep bacteria are defeated, but many good bacteria from Gutville and other parts of the body are hit as well.


The once-thriving bacterial communities throughout the Human Body are now ghost towns.

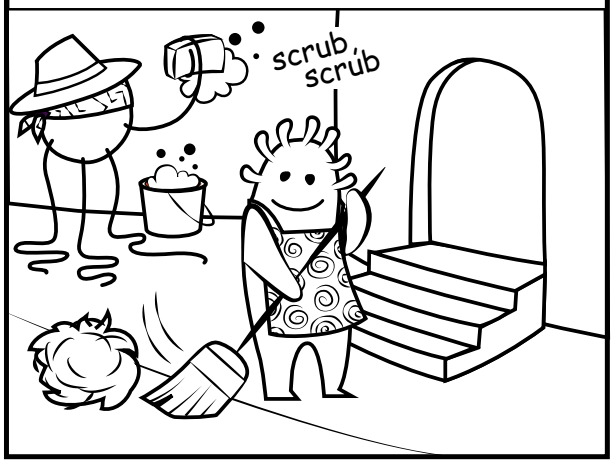
It takes about 3 days for antibiotics to leave the body after the last pill is taken.

To help normal bacteria return, a doctor might recommend eating yogurt.

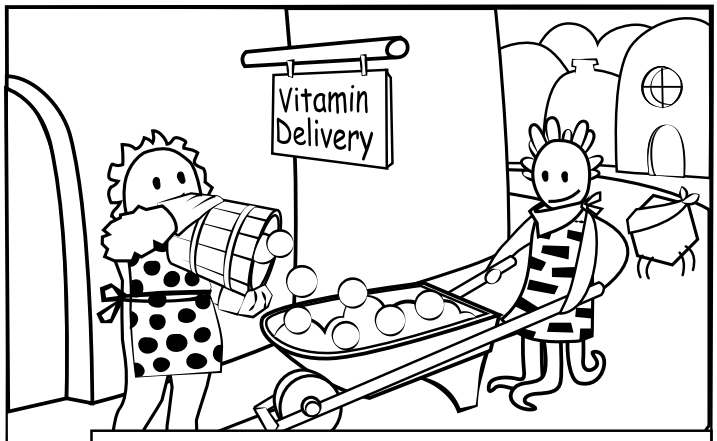
Why yogurt?

It's full of good bacteria called cultures, or probiotics.

Bit by bit, good bacteria return. New bacteria move in to fill the empty spaces left behind.

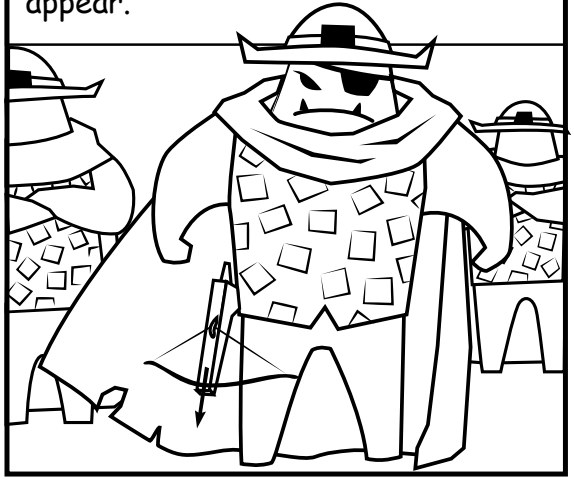


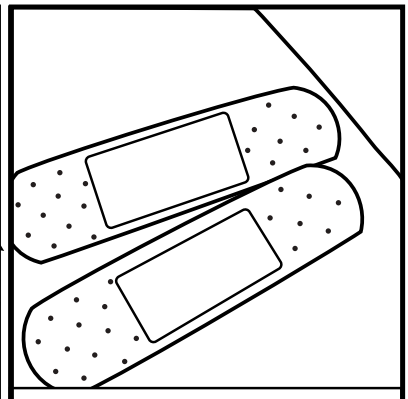
Large families of bacteria move in with the yogurt and other foods.



It doesn't happen overnight but after a while, the towns are back to normal and running smoothly again.

But peace and quiet might not last. One day a new band of strangers appear.





A few came in through a cut in the skin that wasn't properly washed, and they multiplied fast.

They were soon on the move, using the blood stream to travel to other parts of the body.

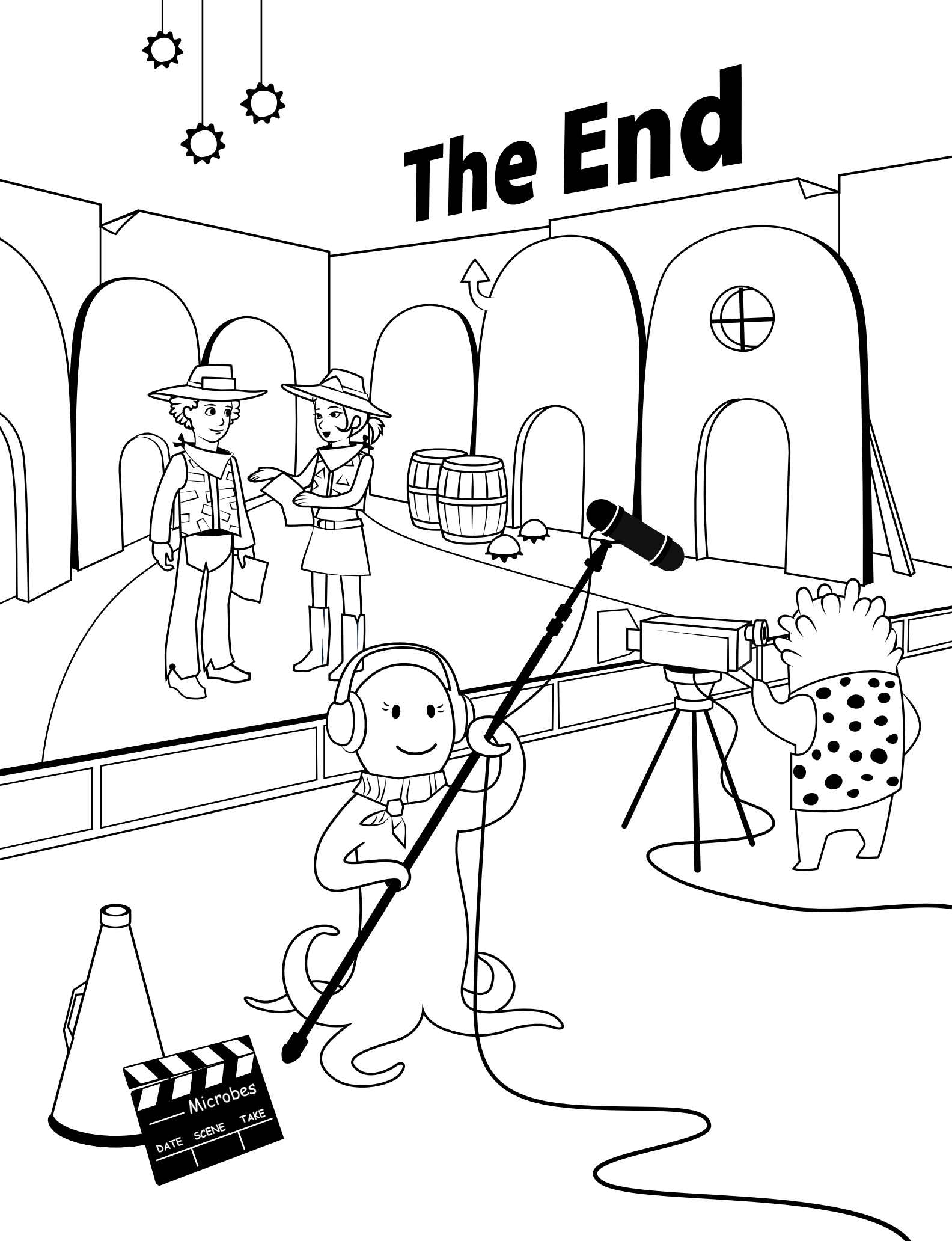

MRSA sets up camp in many places such as the lungs, bone, blood, and skin.
Let me introduce myself: I'm MRSA the Resistant.
My gang and I are taking over the entire body!
Better move along MRSA, you're not welcome here!
We know just what to do with your type...
More antibiotics were taken to try to get rid of MRSA. This time, however, something unexpected happened...
Hahaha, you can't hurt me!
Oh no, the antibiotics aren't working!
Taking more antibiotics will only end up hurting us good bacteria.
We're in serious trouble!
This is where cutting edge nanotechnology comes to the rescue!
Who's that??
Nanotechnology deals with making new materials and medicines out of tiny building blocks such as atoms and molecules.
Howdy, folks!


My name is Sheriff Phage.
I've been looking for a real nasty outlaw that goes by the name of...
WANTED
MRSA the Resistant.
WANTED
DEAD OR ALIVE
MRSA
FOR ANTIBIOTIC RESISTANCE, DISRUPTING PEACE
CRIMES AGAINST THE BODY
Don't worry good bacteria, I won't hurt you.
I can tell by your receptors that you're not the ones I need to find.
Receptors? What are those?
Receptors are those little structures on our surfaces.
Their unique shapes let them bind with only certain molecules.
That's right! All bacteria have unique receptors on the outside, kind of like ID badges.
I know I've found the right villain when their receptors match the shape on the end of my guns.


I get it now!
My receptors don't match so you know I'm not MRSA.
Yes, exactly!
Phage Virus... we meet again!
MRSA the Resistant.
This body isn't big enough for the both of us.
rustle... rustle... rustle...
GASP!
whoosh!
click-click
BANG!


Gahhh!
Thunk!
Zap!
Urg...
whoosh
Phage Virus just defeated the boss!
Ok, who's next?
We better get out of here quick!
Thank you so much!
You spared us good townsfolk from MRSA's gang when antibiotics weren't enough.
No problem! My work is not finished yet.
My posse of phage viruses will keep looking for MRSA's gang.
We won't rest until all of those villains have been defeated.
THE END
Good luck!
Bye!
The body can rest soundly again, knowing it's safe thanks to our heroes watching over it.

The End



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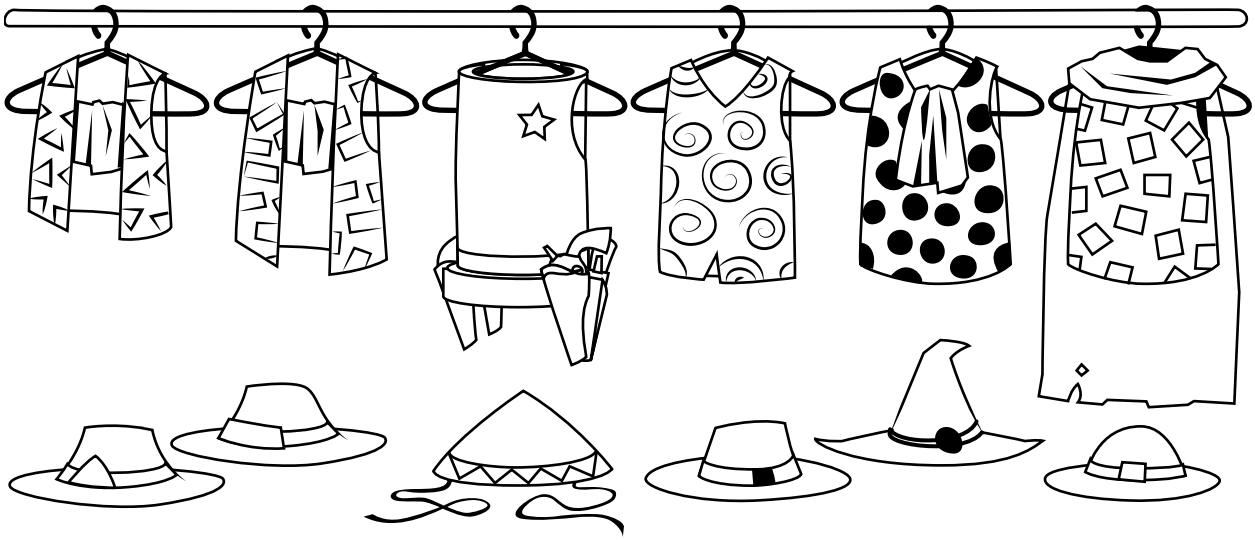
Plan your next visit to Arizona Science Center and play the part of your favorite microbe in the live demonstration, Microbes: The Good, The Bad, and The Ugly.



BODY DEPOT

Arizona Science Center and Ask A Biologist have joined forces in building Body Depot, a place where you can learn about your amazing body. Visit Body Depot online at **askabiologist.asu.edu/body-depot**

MONSTER MANUAL

Read a real monster tale about the tiny instruction manual that you carry around in each of your cells. Then try out Monster Builder, a fun game where you decode and build your own monsters. You can find it at **askabiologist.asu.edu/monster-manual**