



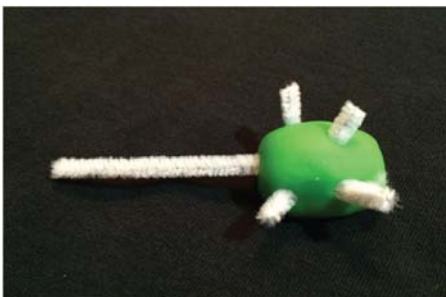
Introduction to Pathogens¹

Supplies

- Pipe cleaners (2 per group; one whole, eight ¾-inch and two 3-inch pieces)
- Cotton balls (15 per group)
- Coffee straws (1 per group cut into 3 pieces)
- Play-doh (1 ounce per group)
- Double sided tape
- Small balloons (1 per group)
- Dry beans (10 per group)
- Pencil (1 per group)

Activities

1. Divide the youth into groups of 3-4 (depending on the size of your group).
2. Read the below to the youth:
 - a. Nearly every animal and human gets sick at some point. When an illness is caused by a pathogen (a virus or bacteria), it can spread quickly through a herd or flock, or from animal to human or human to animal. Some pathogens travel through the air (after a sneeze, for example) and some travel from pen to pen or even farm to farm on people's shoes or on the tools or equipment they move from one site to another. Today, we'll determine what a pathogen is by exploring the various kinds of pathogens.
3. Pass out the pipe cleaners, cotton balls, play-doh, double-sided tape and pencil.
4. Read the below to the youth:
 - a. Pathogens play an important role in our lives. You may have heard pathogens mentioned often, but what exactly are they? We are going to start by learning about bacteria. Bacteria come in several different shapes and sizes. We are going to look at the science behind three different types of bacteria. To start, combine all of your play-doh to form a log shape. (Allow time for each team to construct a log shape.) What you have just created is called "rod-shaped" bacteria. Split the play-doh in half and give it to the person next to you. Reproduction took place and now there are two bacteria.
5. Have youth stick the pipe cleaner pieces into the play-doh log like the below picture.



Model of zoonotic
bacteria – Rod-Shaped

6. Read the below to the youth:

- a. If we take a look at our bacteria, we see they are log or “rod” shaped. When we split them in half we demonstrated how they reproduce – they create a copy of themselves. The shortest pipe cleaners represent “pili,” small hair-like extensions that help bacteria adhere to cells. The longer pipe cleaner pieces represent “flagella,” which help bacteria to move. Not all rod-shaped bacteria have pili or flagella, but some have pili or flagella, or both. Examples of rod-shaped bacteria are Salmonella and E.Coli. We have successfully made our first type of bacteria.

7. Review the below table with the youth:

Type	What it represents	Example
Bacteria: Rod-Shaped	The modeling clay represents the majority of the bacterium, while the pipe cleaners represent pili and flagella that bacteria can use to sense their environment.	Salmonella, E. coli

8. Have the youth use the cotton balls and double-sided tape to make Cocci (Kok-sigh) bacteria like the below picture. Encourage them to be creative.



Model of zoonotic bacteria – Cocci

9. Read the below to the youth:

- a. Although you formed many different shapes, each single cotton ball within that shape represents an individual bacteria. These cocci bacteria are round like a ball, but they often like to cluster into interesting shapes. An example of this kind of bacteria is Mycoplasma, which infects pigs and poultry. Mycoplasma gallisepticum in chickens often causes respiratory disease symptoms such as coughing and difficulty breathing.

10. Review the below table with the youth:

Type	What it represents	Example
Bacteria: Cocci	Each cotton ball represents a bacteria. These bacteria can make different formations and form chains, clumps and more.	Mycoplasma

11. Read the below to the youth:

- a. We will now make a spirochete bacteria. Take the single full-length pipe cleaner and wrap it around the pencil. Then slide the pipe cleaner off of the object. (See picture below) This represents a spirochete bacteria. It is long, can coil and tends to be flexible. This is another commonly found shape of bacteria. Borrelia burgdorferi is one of the largest concerns as it causes Lyme disease.



Model of zoonotic bacteria – Spirochete

12. Review the below table with the youth:

Type	What it represents	Example
Bacteria: Spirochete	The pipe cleaner represents the bacteria in its entirety. These bacteria tend to be long and can coil due to increased flexibility.	<i>Borrelia burgdorferi</i> (causes Lyme Disease)

13. Pass out the coffee straws, balloon and beans.

14. Have each group place beans inside the balloon. Then one person should blow up the balloon and tie it off.

15. Next, youth should use the double-sided tape to stick the cotton balls and cotton balls/straw combinations randomly across the surface of the balloon. See picture below.



Model of Virus

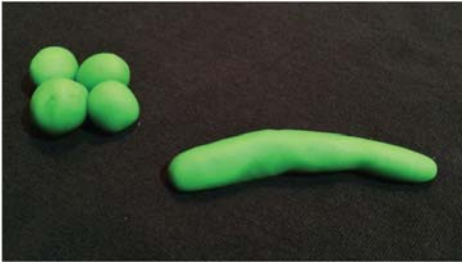
16. Read the below to the youth:

- a. Viruses are usually hard to see, but we made ours so that we can clearly identify the various structures. In our case, the balloon represents the outer membrane of the virus. The beans that we put on the inside are its genetic material (DNA or RNA) – that’s what it gives to the cell so the cell has a blueprint for making more viruses. The cotton balls and cotton-ball-with-straw combination that we put on the outside represent the various kinds of proteins found on the outside of the virus. These can have many different purposes: they can help the virus attach to a cell, enter their genetic material or “blueprints” into the cell, help with the release of viral particles and more. An example of a virus is influenza. Influenza is a common virus that is responsible for many different kinds of flu in humans as well as pigs, ducks and other animals.

17. Review the below table with the youth:

Type	What it represents	Example
Virus	The balloon represents the outside membrane of the virus, while the beans inside represent the genetic material of the virus. The cotton balls and cotton balls with straws represent two components that help the virus to bind to and to inject their genetic material into other cells.	Influenza

18. Inform the youth that they will reuse the play-doh from earlier to make a parasite.
19. Have the youth use half of their play-doh to form a long worm and the other half to form eggs. See picture below.



Model of zoonotic parasite – Roundworm and eggs

20. Read the below to the youth:
 - a. Parasites can be very different in shape and size. A roundworm is an example of an internal parasite, which means it is found inside the animal. Examples of external parasites include ticks, lice and mites. The worm you created represents a mature roundworm. The round balls represent eggs from which a worm will hatch. Most parasites hatch from eggs.
21. Review the below table with the youth:

Type	What it represents	Example
Parasite	The long tubes represent mature worms, while the small balls represent eggs that have not yet hatched.	Roundworm

22. Read the below to the youth:
 - a. Today, we have made our own versions of these pathogens: bacteria, viruses and parasites. Pathogens are common concerns for those individuals raising animals as well as in everyday life. Humans need to be aware of their surroundings and take precautions to try to avoid pathogens that we may or may not be able to see. Pathogens generally reproduce quickly so taking precautions is important to keeping humans and animals safe and healthy.
23. Ask the youth the following reflection questions.
 - a. What are the three main types of pathogens that we made today?
 - b. What differences are there between these three types in how they make more of themselves?
 - i. Bacteria reproduce by making a direct copy of themselves. Viruses use a host cell to make more viruses. Parasites make eggs, and hatch from these eggs to become mature parasites.
 - c. What common diseases can these pathogens cause?
 - i. Bacteria can cause Lyme disease, as well as sickness from *Salmonella* or *E.coli*. Influenza is a common virus that is responsible for many different kinds of flu. Parasites can infest an animal and cause problems such as roundworm.
 - d. What precautions can you take to help prevent you and your animals from getting ill?

¹This activity was adapted from the “What is a Pathogen?” activity that is part of Animal Science Anywhere, Michigan 4-H, Michigan State University Extension, http://msue.anr.msu.edu/resources/4_h_animal_science_anywhere.