

**4-H at  
HOME**



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# DEFENSE DEPARTMENT

Learn how the immune system helps humans and animals fight off illnesses.



# Defense Department

Learn how the immune system helps humans and animals fight off illnesses.

## About the Activity

*This is the first in a four-part educational series about preventing and treating illness in animals. You can see the other activities on [4-H Veterinary Science on 4-H at Home](#).*

This fun and educational activity will show kids how the body's immune system works and how it protects animals and humans against sickness. Plus, there's candy involved, so it should be a hit.



## Supplies

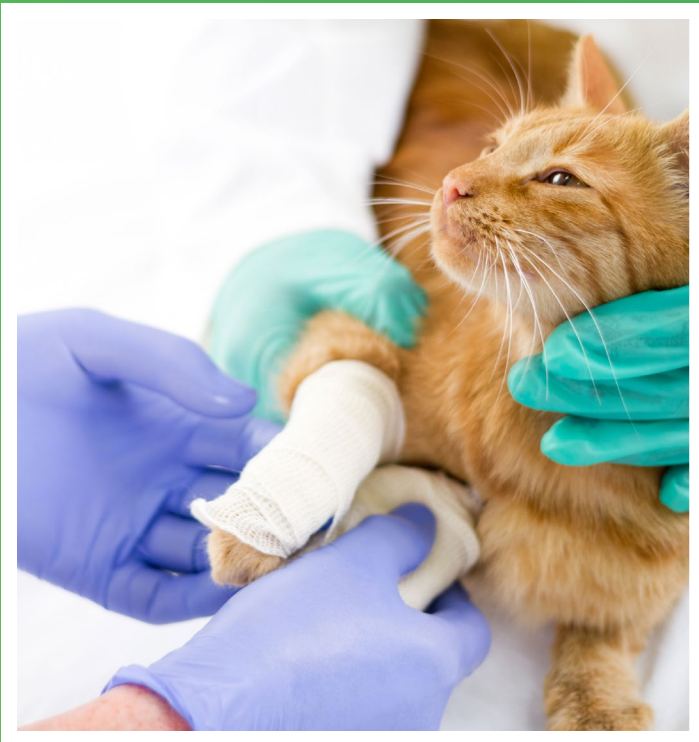
**These simple materials will get you started:**

- A pencil or pen
- Internet access to research the immune system
- A bag of M&Ms, jellybeans or other multi-colored candy
- A calculator
- The downloadable activity guide PDF with information on immune systems

## Grades: 6-8

**Topic:** Animal Science

**Time:** 60 minutes



# Activity Steps

**Before we start, think about this:** Having a fever is not fun, but when you — or an animal — are sick, it's actually a good sign. That's because fevers have been shown to "turn on" the immune system, helping the body fight infection. So you may feel sick when you have a fever, but that's because your body is working hard to protect itself! Now, let's get started. Follow these steps to complete the activity.

**1** To start, read through the downloadable activity guide and glossary and the information about the immune system. There's some pretty amazing stuff in there. For instance:

**DID YOU KNOW:** Lymphocytes are white blood cells that support your immune system by attacking pathogens (any microorganism that can cause sickness in your body). They are found in the bloodstream and lymph nodes.

**ALSO:** Erythrocytes are red blood cells that carry oxygen from the lungs to the body's tissues.

**2** Now it's time for M&Ms! Open your bag of candy and sort the pieces according to color. Put the color group with the most pieces at the top of your working area; put the group with the second-most pieces below this, and continue until the group with the fewest pieces is at the bottom.

**NOTE:** A typical bag of M&Ms has six colors in it, so if you don't have enough different colors to do all eight of the blood cell types, that's fine, the basic idea is still the same.

**3** Count the total number of "cells" you have and record this number.

**4** Assign a blood cell type name from the list in the matching activity to each color of candy.

**5** Finish performing your Complete Blood Count by counting the number of each color candy, then calculating the percent of each type of "cell." The total of all candy percentages should equal 100.

**TIP:** To calculate a percentage, divide the number of a specific color candy by the total number of cells. Then multiply that by 100 to convert that decimal to a %.

For example, if you have 10 red pieces of candy and 36 total pieces, you would calculate the percentage as  $10/36$ , which equals 0.27. Multiplied by 100, you get 27.7, and that's your percentage of red candies: 27.7%

**DID YOU KNOW:** A Complete Blood Count is also called a CBC, for short, which is a set of medical lab tests that gives information about the types of cells in a person's blood.

**6** Record your results in the corresponding table, then refer to the Normal Blood Count chart for different animals. Based on your totals, do you have a healthy level of blood cells for a cat? For a dog? For a cow?

**TIP:** A cat has 6-20 white blood cells (x1000); a dog has 6-17; and a cow has 4-12.

Color of Candy	Cell Type Assigned	Number Counted	Percent of Total

## Glossary of Terms

### **Basophil** (BAZE-oh-fill):

A type of white blood cell; precursors of macrophages; circulate in bloodstream; leaves vessels and enters tissues in response to disease-causing agents; engulf invaders and kills them with enzymes.

### **Eosinophil** (ee-oh-SIN-oh-fill):

Also known as platelets; important in blood clotting process.

### **Erythrocyte** (ee-RITH-row-site):

A type of white blood cell; circulates in bloodstream and present in thymus, lymph nodes and spleen; produces antibodies when activated by invading pathogens.

### **Lymphocyte** (LIMF-oh-site):

A type of white blood cell; derived from monocytes; found in tissues; engulfs invaders and destroys them with enzymes.

### **Macrophage** (MAK-row-faj):

A type of white blood cell; rare; function poorly understood.

### **Monocyte** (BAZE-oh-fill):

A type of white blood cell; precursors of macrophages; circulate in bloodstream; contains granules full of enzymes; engulfs invading organisms and destroys them with enzymes.

### **Neutrophil** (NEW-trow-fill):

Also known as red blood cells; contains hemoglobin and carries oxygen from the lungs to the tissues.

### **Thrombocyte** (THROM-bow-site):

A type of white blood cell; numbers increase in response to allergic or parasitic conditions; circulates in the bloodstream.

## Normal Blood Cell Counts of Various Species

	Cat	Dog	Cattle	Horse	Pig	Hamster	Rabbit
White Blood Cells x1,000	5.5-19.5	6-17	4-12	6-12	11-22	5-10.6	5.2-12.5
% Neutrophil	35-78	60-80	15-47	30-76	28-51	17-35	17-59
% Lymphocyte	20-55	12-30	45-75	25-60	39-62	51-92	31-80
% Monocyte	0-14	3-14	2-7	1-8	2-10	.4-4.4	0-13
% Eosinophil	2-12	2-10	2-20	1-10	1-11	.2-1.5	0-3.4
% Basophil	0-2.5	0-2.5	0-2	0-3	0-2	0-5	0-5.6
Red Blood Cells x1,000,000	5-11	5.5-8.5	5-10	6-12	5-8	4-10.3	5.1-8
Platelets x1,000	150-500	200-500	100-800	100-600	325-715	300-573	270-656

# Test Your Knowledge

## How much did you learn about the immune system?

### QUESTION 1

What is the main function of a red blood cell?

- a. Fights disease
- b. Carries oxygen from the lungs to the rest of the body
- c. Regenerates healthy cells
- d. Transmits information throughout the body

### QUESTION 2

What's another name for a platelet?

- a. Thrombocyte
- b. Neuron
- c. Basophil
- d. Erythrocyte

### QUESTION 3

True or false? Antibodies promote diseases in animals.

- a. True
- b. False

### QUESTION 4

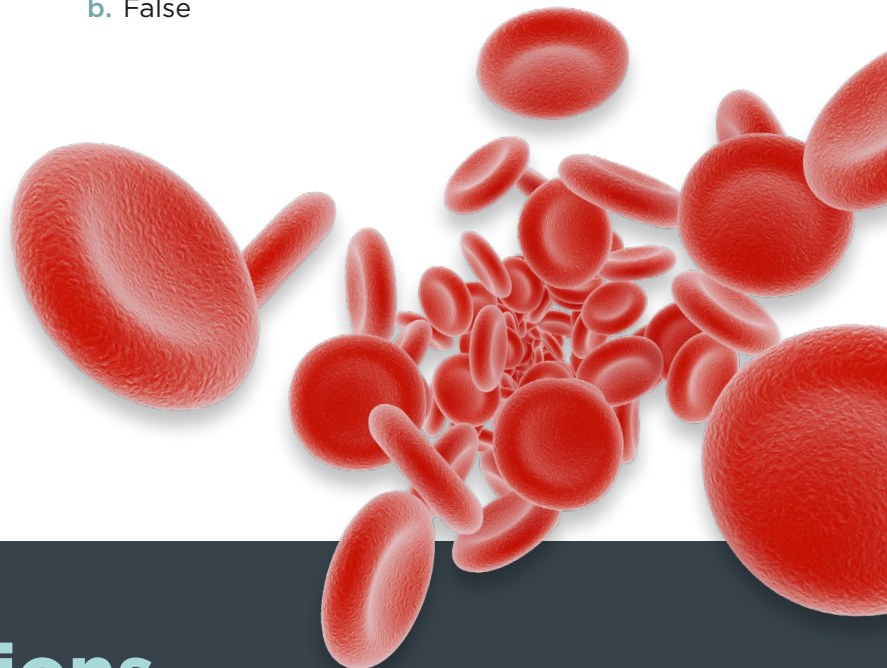
What's the most abundant type of white blood cell?

- a. Macrophage
- b. Basophil
- c. Neutrophil
- d. Monocyte

### QUESTION 5

True or false? Results from a CBC can help diagnose diseases.

- a. True
- b. False



## Reflection Questions

### Questions to deepen wonder and understanding

- How does the immune system protect us against diseases?
- How can you better protect your pets or animals (if you have any) against diseases?
- What diseases have you been vaccinated against?

# Investigate & Explore

Take your new knowledge to the next level.

Humans have been studying blood for a long time. The invention of the compound microscope in 1590 made it all possible, and less than a century later the Dutch scientist Jan Swammerdam was the **first person** to observe red blood cells under the microscope, in 1658.

Over the centuries we've learned a lot about how the different kinds of blood cells drive the immune system, helping it to protect the body by fighting off illnesses. And science has progressed to help the immune system support itself with the evolution of medicines and vaccines. Vaccines are injections that contain the same germs that cause a disease, but that have been weakened so they can't make the body sick; instead, the immune system is stimulated to produce antibodies against the vaccine and, in turn, develops immunity against the disease the vaccine was created against.

The first vaccine was used in 1796 to provide protection against smallpox, but the story of vaccines began long before that. There's evidence to suggest that the Chinese employed smallpox inoculation — not by vaccine, but by exposing a healthy person to a smallpox scab — as early as 1000 CE. Explore more about the history of vaccines [here](#).



There are all kinds of diseases that used to be common that, thanks to vaccines, we don't have to worry about anymore, including polio, measles, and smallpox.

*This is the first in a four-part educational series about preventing and treating illness in animals.*

***To see the other activities in this series, visit our [Stopping Sickness activities page](#).***

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# BIOSECURITY DOMINOS

See how quickly illnesses can spread—or be stopped in their tracks.



# Biosecurity Dominos

—  
See how quickly illnesses can spread—  
or be stopped in their tracks.

## About the Activity

*This is the second in a four-part educational series about preventing and treating illness in animals. You can see the other activities on [4-H Veterinary Science on 4-H at Home](#).*

We know that viruses and illnesses can spread rapidly from one person to another. Think about when someone in your family gets a cold: A lot of times, once one person in the house gets it, it quickly spreads to others, too. Well, the same thing can happen among animals on a farm, too, because when one animal gets sick it can easily quickly spread that illness to others – after all, there’s only so much space in a barn!

In this activity, kids will use dominos (or something similar), arranging them in different ways to simulate how illnesses are spread and stopped. In this activity, each block represents an animal, and each fallen block represents an animal getting sick.

## Supplies

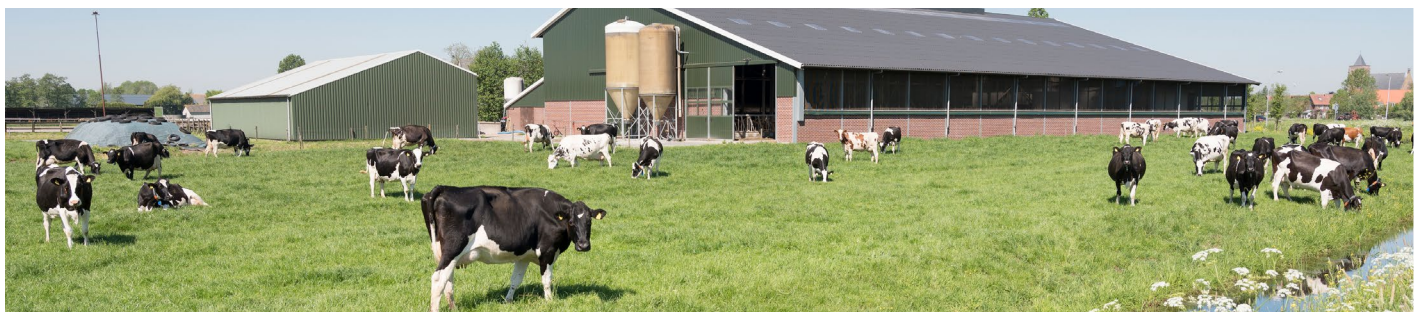
**These simple materials will get you started:**

- Dominos, Jenga blocks, or something similar.
- A checkerboard, table top or some other small, flat surface

## Grades: 6-8

**Topic:** Animal Science

**Time:** 25 minutes





# Activity Steps

- 1 Place 15-20 dominos on your flat surface in a space about the size of a checkerboard. Arrange them and space them so that when you knock one down, it will hit the next one, which will hit the next one, and so on, until all the dominos are knocked down.

**DID YOU KNOW:** Diseases and other illnesses can spread in a lot of ways. Sometimes that is when an animal directly puts the pathogen (any microorganism that can cause an illness), into another animal's body. If that sounds strange, think about one of the most common ways that happens - mosquitoes. Animals like mosquitoes that directly infect another animal are called vectors.

- 2 Now, set the dominos up again. This time, arrange them so that one domino knocks down all the others, except for one.

**DID YOU KNOW:** An animal that is carrying an illness but doesn't show any signs, or symptoms, is called a reservoir.

- 3 Finally, set the dominos back up and arrange them so that when you knock one down, none of the others are knocked down.

**DID YOU KNOW:** Biosecurity is an action taken to prevent sickness from spreading. Some forms of biosecurity include increasing the physical distance between animals (or people) apart, quarantining sick animals (keeping the sick ones apart from the well ones), and by using vaccines to make animals immune to certain illnesses (being immune means your body has the ability to resist a given illness).



# Test Your Knowledge

## See how well you know biosecurity?

### QUESTION 1

What is biosecurity?

- a. A biology textbook stored safely in your school locker
- b. A snack people ate a long time ago
- c. Actions taken to prevent illnesses from spreading
- d. Safely stored food products

### QUESTION 2

What is an example of an animal vector?

- a. A mosquito
- b. A horse
- c. A seahorse
- d. A slug

### QUESTION 3

What does having biological immunity mean?

- a. That you can't hear very well
- b. That you are in a barn with a lot of sick animals
- c. That your body has the ability to resist an illness
- d. That you've already been sick, and can't get sick again

### QUESTION 4

What is one way to increase biosecurity in a group of people or animals?

- a. Increasing physical distance
- b. Quarantining
- c. Vaccines
- d. All of the above

### QUESTION 5

True or false? A pathogen is another name for a microorganism that can cause sickness?

- a. True
- b. False

## Reflection Questions

### Questions to deepen wonder and understanding

- How are the blocks that you used for the activity a model for how sickness can spread between animals or people?
- What type of diseases have you seen or heard about spreading between animals, or between people?
- Have you heard of any illnesses that can spread between both animals and people?
- What do you do to prevent germs or illnesses from spreading in your home or at your school?



# Investigate & Explore

## Take your new knowledge to the next level.

You're probably a lot more familiar with the concept of disease spread now than you were before the coronavirus pandemic broke out in 2020. But the same principals have always applied to limiting the spread of sickness, and farmers have always been especially concerned with that. That's because if one animal gets sick, it is very easy for the rest of the animals around it to get sick, and those animals are a farmer's livelihood.

Now, we all understand how important it is to limit the spread of germs and pathogens. And the same fundamentals that mattered before the coronavirus still matter now: regularly washing your hands, sneezing into your elbow, and limiting your exposure to other sick people always have been and always will be the best ways to keep yourself - and others - healthy.

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# SICK OR WELL: HOW CAN YOU TELL?

Similar to people, animals also have signs to let us know when they're under the weather. Can you recognize them?



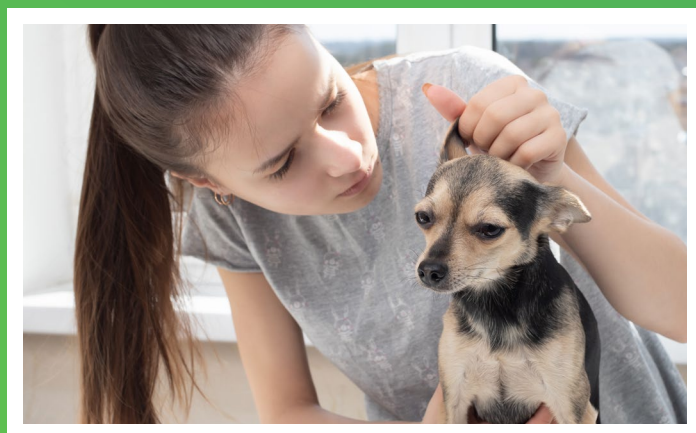
# Sick or Well: How Can You Tell?

Similar to people, animals also have signs to let us know when they're under the weather. Can you recognize them?

## About the Activity

*This is the third in a four-part educational series about preventing and treating illness in animals. You can see the other activities on [4-H Veterinary Science on 4-H at Home](#).*

When we're sick, our body and mood have ways of showing us and the people around us that we aren't well. Animals do this too. Using the downloadable symptom chart attached to this page, kids will observe and examine their pets for symptoms that may indicate they may be sick. Most likely your pets feel fine, but the lesson works just fine either way. Note that this activity will work best with a cat or a dog – but if you don't have any pets at all, you can walk through these activity steps and make note of the symptoms that demonstrate illness and those that don't.



## Supplies

**These simple materials will get you started:**

- A pet, preferably a dog or a cat
- A pen or pencil
- The downloadable symptom chart attached to this activity
- A flashlight
- *Optional: Pet treats or comfort toys*

## Grades: 6-8

**Topic:** Animal Science

**Time:** 30-60 minutes

## Activity Steps

Follow these steps to conduct an examination of your cat or dog.

- 1 To begin this activity, find a comfortable space to conduct your examination. Pets can be squirmy and skittish, so it's best to have your space set up before bringing your pet into the examining room.

**DID YOU KNOW:** It's important for pets to have regular exams, even when they seem healthy. This is like when you go to the doctor for a checkup. Regular exams can **help to detect potential health issues** early on. There are other preventative measures your veterinarian may recommend for your pet, as well, such as vaccinations. These are important for preventing **certain diseases** like rabies.

- 2 Once your examination space is set up, it's time to bring in your patient. Placing a toy or comfort object by your pet may help to keep them still and calm. Depending on the temperament of your animal, you may want to ask a helper to hold them while you conduct your exam.

- 3 Now, use the downloadable symptom chart and the questions in it to guide your exam. Put a check in the appropriate box. This may require some critical thinking. For example, is it a healthy sign when a cat has a slightly moist nose?

**TIP:** Some of the symptoms you're looking for aren't cut and dry. If your cat has watery eyes sometimes, and they do when you observe them, they may be fine. But if your cat rarely or never has watery eyes and does when you observe them, they may be sick. Some of these require you to use your best judgement – just as a veterinarian would do.

**NOTE:** If you mark sick for any of the below observations, talk to your grownup about calling your pet's veterinarian.

## Symptoms Charts

If you don't have a pet, put a check next to whether you think each symptom or sign would refer to a healthy or sick cat or dog.

Ears, Eyes, Nose, and Throat	Healthy	Sick	Notes
Mouth is pink and moist (healthy)			
Eyes are dull, dry and sunken (sick)			
Cat scratches ears and shakes head often (relative)			
Nose is clear and slightly moist (healthy)			
Wheezes, coughs or pants a lot (sick)			
Nose or eyes have discharge (relative)			
Other			

# Symptoms Charts (Continued)

Body and Limbs	Healthy	Sick	Notes
Limps or has swollen legs (sick)			
Body appears very thin or overweight (relative, but likely sick)			
Sleek and glossy coat (healthy)			
Breathes quietly; can barely hear it (healthy)			
Runny or bloody stools (sick)			
Moves quickly and with energy (healthy)			
Other			

Behavior	Healthy	Sick	Notes
Hides; doesn't want to play (relative)			
Frequent litter box or bathroom use—more than 10 times per day (sick)			
Has accidents (sick)			
Eats too much or not at all (sick)			
Playful, content, alert attitude (healthy)			
Urinate a clear, yellow fluid an appropriate number of times per day (typically 2-4) (healthy)			
Sleepy, grumpy or restless (relative)			
Other			
Other			

# Test Your Knowledge

## How much did you learn about the immune system?

### QUESTION 1

**True or false?** Animals do not need to see a veterinarian if they are healthy.

- a. True
- b. False

### QUESTION 2

**True or false?** An animal's behavior can help determine if it is healthy.

- a. True
- b. False

### QUESTION 3

**Animals receive vaccines to:**

- a. Get rid of diseases they may already have
- b. Be like people
- c. Avoid catching contagious and dangerous illnesses
- d. Make their pet owners happy

### QUESTION 4

**Which of the following is a sign of a sick cat or dog:**

- a. A slightly moist nose
- b. Urinates regularly, but not too frequently
- c. A lean body that is not too skinny
- d. Runny or bloody stool

### QUESTION 5

**Which of the following is a sign of a healthy cat or dog:**

- a. A slightly moist nose
- b. Wheezing or coughing
- c. Bloody stool
- d. Little or no appetite



## Reflection Questions

### Questions to deepen wonder and understanding

- Why does an animal's behavior tell us how it is feeling?
- When was the last time your pet went to the veterinarian? Was it for a sick or a well visit?
- What are some things you could do to help improve your pet's health? Be sure to check with your grownup/veterinarian before taking action.
- How does your pet act when it is feeling good? How do you think it would act in comparison if it were sick?





# Investigate & Explore

## Take your new knowledge to the next level.

Ask your grownup if you can accompany them the next time they take your pet for a checkup. If pet owners are allowed to accompany their animals, observe how the vet carries out the exam. Ask questions about what the vet sees or hears throughout the exam.

If you are not allowed in the examination room, ask your vet some questions about your pet's health before the exam and see how they report back.

Regardless of which option works for you, discuss what you learned after the exam!

*This is the third in a four-part educational series about preventing and treating illness in animals.*

***To see the other activities in this series, visit our Stopping Sickness activities page.***

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OPTIMAL PET HEALTH

# NOT A SHOT IN THE DARK





# Measuring Medicine for Optimal Pet Health

—  
Learn to keep your pets healthy by putting your math skills to work.

## About the Activity

*This is the final activity in a four-part educational series about preventing and treating illness in animals. You can see the other activities in this series [here](#).*

Do you remember the last time you went to the doctor? Maybe it was because you weren't feeling well, or maybe it was just for a checkup. Most likely, when you arrived, the nurse asked you to step on the scale. That part might not have seemed important at the time, but it probably helped the nurses and doctors guide how to treat you.

Weight plays a similar role with our pets. When a vet checks an animal's weight, they can learn a lot about the animal's health and how much medicine to give them if they are sick. With that in mind, we are going to learn how to measure medicine by weighing the people or animals in our household and applying some basic math. Then we'll make a pretend medicine, and pretend to give it to our patients. Ready to put your veterinarian skills to the test?



## Supplies

**These simple materials will get you started.**

- A pen or pencil
- A piece of paper
- A measuring cup
- Regular cups
- Measuring spoons
- Water
- A scale
- The downloadable conversion chart attached to this activity
- Optional: A calculator
- Optional: food coloring

## Grades: 6-8

**Topic:** Veterinary science

**Time:** 30 minutes





## Activity Steps

Follow these steps to determine how much “medicine” to administer:

### Part 1: Weigh your patient

- 1 Decide which people or pets in your house are going to be your patients. For younger veterinarians, it may be easy to start with people. You can pick a grownup, sibling, or any other friend who is willing to participate.

**OPTIONAL:** You may also select a pet that lives in your home to be one of your patients, with adult supervision. It’s probably a good idea to stick to pets that are easy to hold, and that live on the ground. Pets like fish, birds, or amphibians are probably not good for this activity, since they either need water to survive or are not easy to hold. If you have an animal like a cat that doesn’t like to be held, choose a different pet.

- 2 Record your patients’ weight, bringing them our scale one at a time. Have each patient step on the scale and record their weight on the chart below.

**TIP:** If you have decided to weigh a pet, it will probably be difficult to capture their weight without help. To do this, ask one of your people patients for help and try the following:

1. Have your helper stand on the scale, and write down their weight.
2. Now have your helper stand on the scale again, but this time, while holding your pet. Write down that weight, too, using the example in the following chart:

Helper’s weight	150 pounds
Helper’s + Pet’s weight	170 pounds
Pet’s weight	???

3. Subtract the first number you identified from the second one. The difference should be equal to your pet’s weight. Put that final number into the downloadable conversion chart that is a part of this activity.

**EXAMPLE:** To find your answer, write down the second number, then subtract the first:

170 pounds - 150 pounds = 20 pounds.  
So, in this example, your pet would weigh 20 pounds!

**DID YOU KNOW?** Maintaining a healthy weight can help animals to live a long and healthy life. Pets that have a healthy weight are **less prone to illnesses** like diabetes, high blood pressure, arthritis, and kidney disease. They are also less likely to suffer from injuries.

### Part 2: Calculate their dosage

- 1 For this particular experiment, your patient should receive 1 cubic centimeter (cc) – sometimes referred to as a milliliter – of medicine for every pound they weigh. For example, a 20-pound dog would receive 20 cc of medicine.

- **1 cubic centimeter (cc) = 1 milliliter (ml)**
- **5 cc = 1 teaspoon (tsp)**
- **30 cc = 1 ounce (oz)**
- **8 ounces = 1 cup**

...Part 2: Calculate their dosage continued on next page



- 2 Use the attached conversion chart to plan out how much you are going to give to each of your patients.
- 3 Using water and your measuring spoons, serve out the number of teaspoons your patient needs into a cup. For example, if your patient needs 4 teaspoons of medicine, fill your teaspoon with water and place the water into a cup 4 times. If your patient needs 30 teaspoons of medicine, do this 30 times!

**TIP:** Want to make it more fun?

Add some food coloring to the medicine and mix it up! But to keep from spreading germs, we don't suggest making anyone drink the medicine, whether it has coloring in it or not.

**DID YOU KNOW?** There's a faster way to measure out 30 teaspoons of medicine for a patient? See the bonus activity step below to learn more.

Patient	Weight	Dosage Rate	#CC   5CC	Amount Given (TSP)	Amount Given (OZ)
Grownup 1	150 pounds	1cc per pound	150cc   5cc	30 teaspoons	5 ounces
Pet 1	20 pounds	1cc per pound	20cc   5cc	4 teaspoons	2/3 ounce

### Bonus Activity Step:

Early in this activity, we asked if there was a better or faster way to measure out 30 teaspoons of medicine. **There is!**

If you want to further challenge your math skills, try converting cc to ounces.

- **Remember:** 30 cc = 1 oz
- Feel free to use a calculator or ask a grownup to help if you need some extra support. Use the chart above to fill in your answers!

**DISCLAIMER:** Take medication correctly and only when directed by a doctor. This activity uses a harmless liquid as a "medication," but you should never play with medicines, take or administer them to others!





# Test Your Knowledge

## Test Your Knowledge

What have you learned about giving medicine to animals?

### QUESTION 1

What does weight tell us about our pets?

- a. If they are healthy
- b. If they are happy
- c. If they are smart
- d. How much medicine they need if they are sick
- e. Answers A and D

### QUESTION 2

Animals that maintain a healthy weight are less likely to:

- a. Have diabetes
- b. Have high blood pressure
- c. Have pain from arthritis
- d. Have kidney problems
- e. All of the above

### QUESTION 3

**True or False:** The easiest way to measure the weight of a squirmy animal like a dog or a cat is have someone hold the pet while standing on the scale, then weigh that person by themselves, and subtract the weight of the person alone from the weight of the person holding the pet.

- a. True
- b. False

### QUESTION 4

**Fill in the blank:** 1 cubic centimeter (cc) is equivalent to \_\_\_\_\_ :

- a. 1 milliliter
- b. 1 tablespoon
- c. 1 teaspoon
- d. 1 ounce

### QUESTION 5

**Fill in the blank:** 30 cubic centimeter (cc) is equivalent to \_\_\_\_\_ :

- a. 1 milliliter
- b. 1 teaspoon
- c. 1 ounce
- d. 1 cup

## Reflection Questions

Questions to deepen wonder and understanding.

- Why are math skills important for veterinarians?
- What could happen if you give an animal the wrong amount of medication?
- What other ways can animals receive medication aside from drinking it?
- What kinds of situations would require an animal to receive a different type of medicine than liquid to drink? Are there situations where an animal might receive a cream/salve or a pill instead?
- What other types of medicines are out there that you haven't talked about yet?



# Investigate & Explore

Take your new knowledge to the next level.

Pets and animals get sick, just like humans. Dogs, for example, can get common sicknesses like heartworm and kennel cough. Illnesses like these are treatable with different types of medicine – and the amounts of these medicines an animal would get would be based on how big they are.

Other common dog illnesses like distemper or parvo are also treatable with medicine, but the best treatment for those kinds of diseases is to stop them before your animal can ever catch them, with vaccines.

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