Lesson title:
Antibiotics in Agriculture

Overview:
Antibiotics are a group of drugs that are used to treat and prevent bacterial infections. In this activity, students will investigate how antibiotics work and what they are used for in animals and humans. Students will investigate how antibiotics are a tool for reducing animal disease and to treat bacterial infections. As an extension, students will design and record a whiteboard animation that educates consumers on the potential benefit of using probiotics to maintain the health of livestock.

Objectives
Students will be able to:

- Describe how antibiotics kill bacteria cells
- Explain ways that antibiotics are used in the agriculture industry
- Create a whiteboard animation using information students obtained on probiotic use in agriculture

Materials

- Computer connected to the internet and projector for showing the video
- Copies of the KWL chart
- Copies of the Antibiotics T-Chart

Have you ever wondered . . .
How antibiotics destroy bacteria?
Why antibiotics cannot fight viral infections?

Make connections!

How does this connect to students?	**How does this connect to careers?**	**How does this connect to our world?**
Responsible use of antibiotics, such as those prescribed for ear and throat infections, involves completing	**Agricultural Food Scientists** explore animal genetics, nutrition, reproduction, diseases, growth, and development. They also	Farmers and ranchers are making efforts to reduce antibiotic use. In the process, they have adapted their

finishing the antibiotics course prescribed by the doctor. Ask your doctor to prescribe medicines that you need to take only once or twice a day, since fewer doses will help you remember the course of your medicines and help reduce antibiotic resistance.	advise farmers on how to lower animal death rate and increase productivity. **Ranch and farm managers** supervise the raising of livestock and poultry or the production of meat and dairy products. People working in this career ensure that we are provided with a healthy supply of protein-rich food. **Agricultural inspectors** ensure that our food supply is safe for consumption by monitoring food production facilities and the equipment used in these facilities.	raising standards to keep animals healthy by altering feed recipes, allowing animals more space, keeping animals with their mothers longer, etc. By keeping animals, like pigs, healthy farmers and ranchers reduce the need for antibiotics.

Blueprint for Discovery

1. Ask students to complete the first two columns of the KWL Plus chart – "Know" and "Want to Know" – individually.

2. As a class, watch the USFRA/Food52 video "A Day on a Dairy Farm" [duration 3 minutes, 57 seconds]
http://www.fooddialogues.com/videos/how-to-farming-series/a-day-on-a-dairy-farm

3. Pause the video and lead a class discussion to elicit the following key points from students:

- Dairy farmers need to make sure their cows are getting the proper amounts of grass and legumes for a balanced, healthy diet.
- The cow's diet is made of a mixture of finely chopped corn silage, alfalfa grass silage, and other nutrients.
- Milk samples from the farm are sent off for quality control tests. Once the milk is unloaded at the plant, it has to pass even more tests. Therefore, milk is one of the most highly regulated foods available.

- Antibiotics on the dairy farm are only used on an "as needed" basis for sick animals. The cows on antibiotics are removed from their normal milking pen until their milk is proven to be clear and antibiotic-free.

Guiding questions for the discussion include,

- How is milk produced by cows regulated?
- How are antibiotics used on the dairy farm?

3. Encourage students to ask questions to clarify their understanding. Refer students to their KWL Plus charts to identify questions or areas for learning that were not answered by the video.

4. Next show students the following short video that explains how antibiotics work:
https://www.youtube.com/watch?v=X1GT2bKgci8
from http://www.e-bug.eu/

5. Have students summarize the difference between the two types of antibiotics, including why both are not effective in killing viruses on the "Antibiotics T-chart".

Pause the video during different segments to emphasize the key points in the following order:

- Write the two types of antibiotics (bacteriostatic and bactericidal) on the board underlining each of their suffixes. The difference in these two terms lies in the meaning of their suffix:

  -cidal = kill
  -static = stay the same

- Bacteriostatic antibiotics slow the growth of bacteria by interfering with the processes (e.g. DNA replication, metabolism, and protein production) bacteria need to multiply.
- On the other hand, bactericidal antibiotics actually kill the bacteria by preventing the bacteria from building a cell wall. Examples of bactericidal antibiotics used in humans include penicillin (for sore throats), amoxicillin (for chest infections), and flucloxacillin (for skin infections).
- It is important to note that not all bacteria are the same and not all antibiotics are ubiquitous. Different families of antibiotics have varying ways of killing bacteria. Bacteria can be selectively eradicated by targeting their unique metabolic pathways.
- Antibiotics can be classified as broad spectrum (affecting all different types of bacteria in your body, including useful gut bacteria) or narrow spectrum (only affecting one or two types of bacteria).
- Most antibiotics have no effect on the immune system.
- It is important to keep in mind that antibiotics do not work on viruses, which have a totally different structure than bacteria. Viruses incorporate themselves into a host cell in order to multiply. Bacteriostatic antibiotics do not attack body cells so they don't slow the growth of viruses. Also, since viruses do not have a cell wall, bactericidal antibiotics that act on cell walls cannot kills viruses.

- Antiobiotics cost farmers and ranchers money. Therefore, economical factors are an important consideration that influence using antiobiotics at the right time, using the right dose, and right type.

5. Clarify any questions students may still have about how antibiotics work, then ask the class, “What could happen if farmers were not able to treat their animals with antibiotics?” "How can farmers and veterinarians work closely together to use antibiotics responsibly?"

6. Use the resources shown below to elicit the following key points from students:
http://www.fooddialogues.com/headlines/antibiotics/can-you-raise-pigs-without-antibiotics
https://www.fda.gov/ForConsumers/ConsumerUpdates/ucm378100.htm

Some key points to emphasize include:

- The FDA has approved antibiotics for these uses in food animals:
    - Disease treatment for animals that are sick
    - Disease control for a group of animals when some of the animals are sick
    - Disease prevention for animals that are at risk of becoming sick
- According to the FDA, the use of antimicrobial drugs, in both humans and animals, has the potential to contribute to the development of resistant bacteria. As such, it is imperative to use these drugs only when it is deemed medically necessary.
- Single sourcing means food animals, such as pigs, need to move to a farm as a group and stay together until they reach market weight. Afterwards, the barns are washed and sanitized to prevent health challenges and reduce the need for antibiotics.
- Veterinarians, food safety technicians, and others work as a team to make important decisions regarding barn design, water quality, and nutrition to ensure animals are cared for in the best manner.
- It costs farmers/ranchers money to treat with antibiotics so they are particularly cautious about using the correct types at the appropriate time and with the appropriate dosage. Responsible use of antibiotics translates into animal welfare/health and these benefits get passed on to consumers.
- Vaccinations can help reduce the need for antibiotics and promote animal health.
- Research on alternative methods, such as probiotics, enzymes, and nutritional additives, may offer additional methods for improving herd health

Additional Resources Include the Following:
http://www.animalagriculture.org/Resources/Documents/Conf%20-%20Symp/Symposiums/2012%20Antibiotics%20Symposium/NIAA%202012%20AB%20White%20Paper%20-Final.pdf

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4975175/

http://www.health.state.mn.us/onehealthabx/about.html

7. Next, instruct students to complete the "Learn" portion of their KWL Plus chart individually. Give students the opportunity to Think-Pair-Share with a partner and then add to the "Learn" segment of their chart following their discussion.

8. Lastly, direct students to complete the "Plus" section of their KWL Plus chart to reflect on the things they still would like to learn about antibiotics and their use in agriculture. Use equitable calling strategies (numbered heads, color-coded cards, equity sticks, calling sticks, online random name generator, etc.) to have students share their questions with the rest of the class.

Take action!
Probiotics are microorganisms that are believed to provide health benefits when they are used properly with humans and animals. Probiotics are found in foods, like yogurt, and are sometimes added to foods. After finding more information on probiotics, design a whiteboard animation that educates consumers on the potential benefits of using probiotics to maintain the health of livestock. A whiteboard animation is a brief, 2-3- minute video, that can be used to communicate scientific information and ideas. First, aim a camera at whiteboard, chalkboard, or erasable surface. Next, start filming and begin drawing, annotating, erasing, and narrating. Identify an audience you can share your presentation to.

Key aspects to include in the whiteboard animation include:

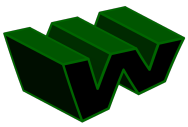
- What are probiotics and how do they work?
- What are the potential benefits of probiotic use in animals?
- How can probiotics be used in conjunction with antibiotics in the care of sick animals within the agricultural industry?

National Standards

Science	**<u>Next Generation Science Standards</u>** **Biological Evolution Unity and Diversity** Students who demonstrate understanding can: **HS-LS4-2:** Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. **ETS1.B: Developing Possible Solutions** • When evaluating solutions, it is important to take into account a range of constraints, including cost,

	safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts

ANTIBIOTICS IN AGRICULTURE

			
What do you **KNOW** about the topic?	What do you **WANT** to know about the topic?	What did you **LEARN** about the topic?	What do you **STILL** want to learn about the topic?

ANTIBIOTICS
T-CHART

Name _____ **Date _____**

Bacterio<u>static</u> Antibiotics	**Bacteri<u>cidal</u> Antibiotics**