

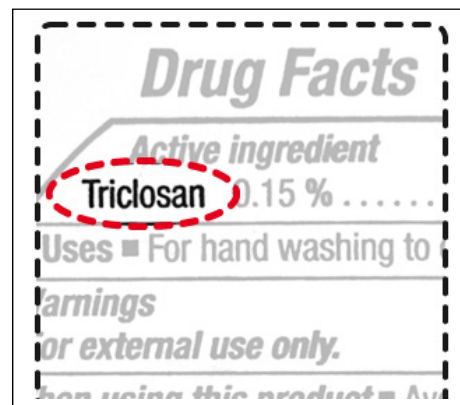
Antimicrobials: Is Keeping Clean Risky?

just add students™

Part 1: Triclosan - An Antimicrobial Chemical

Triclosan is the active ingredient in a wide variety of health care and consumer products. It has been used as an antimicrobial agent since 1972. At low concentrations, Triclosan slows the growth of bacteria. At higher concentrations, it kills bacteria.

Most people don't even realize how frequently they are exposed to Triclosan. When Triclosan is an ingredient in soaps, body washes, toothpaste, and cosmetics, it must be listed on the product label as an active ingredient.



Manufacturers are not required to list Triclosan as an ingredient in antimicrobial clothing, toys, kitchen items, and furniture; therefore you may not even know that these items contain Triclosan. Some antimicrobial products, including plain soap, alcohol-based hand sanitizers and hand wipes do not contain Triclosan.

1. Why is Triclosan added to products?

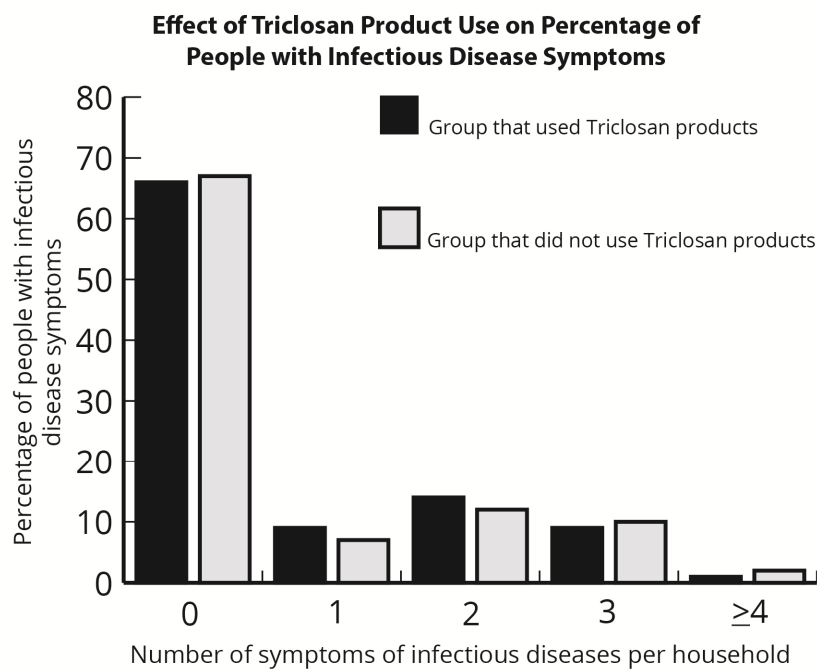
2. How can you tell if products, such as soaps and cosmetics, contain Triclosan?

3. What types of products might not be labeled to indicate that they contain Triclosan?

4. What types of antimicrobial products do not contain Triclosan?

Base your answers to questions 5 through 8 on the research study and graph below.

Researchers investigated whether the use of antibacterial products containing Triclosan leads to a decrease in infectious disease symptoms. They monitored infectious disease symptoms for 238 households (1178 persons), each of which included at least one preschool-age child. Households were randomly assigned to use products for general cleaning, laundry, and hand washing that either contained Triclosan or products that did not contain Triclosan. All products were commercially available, but packaging for the products did not contain information on whether the products contained or did not contain Triclosan. The graph below summarizes the data collected from this research study.



5. What is the purpose of this research study?

6. What is the control group in this research study?

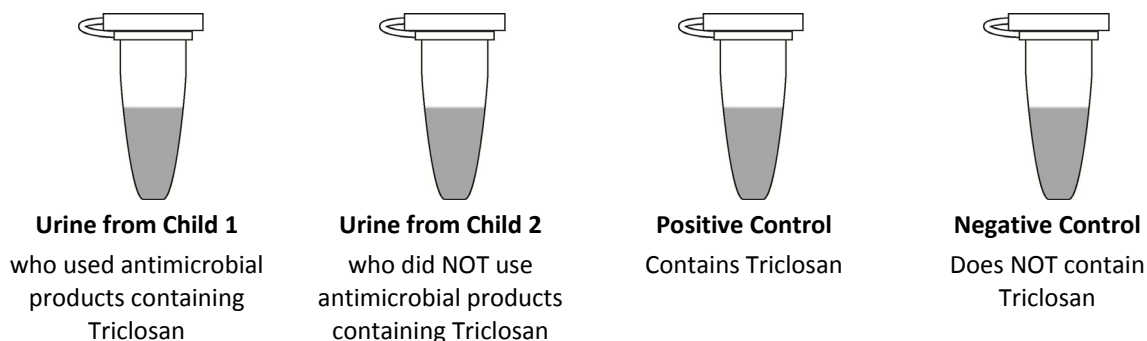
7. Why is it important that the packaging used for the products was not labeled to indicate whether they did or did not contain Triclosan?

8. Based on the graph of the data from this research study, compare the effectiveness of cleaning products that contain Triclosan with the effectiveness of cleaning products that do not contain Triclosan.

Part 2: Testing for Triclosan

The Health Department would like you to conduct tests to determine if Triclosan moves from antimicrobial products into peoples' bodies. The bag labeled "For Part 2" contains the materials that you will need to conduct these tests. You will test four samples for the presence of Triclosan.

1. Make a prediction. Circle the tubes below that you predict the tests will show to contain Triclosan.



2. Use the labeled dropper to add one drop of Triclosan Test Solution to each of the four circles on the **Triclosan Test Sheet**.
3. Use different labeled droppers to add 1 drop of each of the samples (Child 1, Child 2, Positive Control, and Negative Control) to the appropriate circles on the test sheet.
4. Record the results of the Triclosan tests by completing the data table below.

Sample	Color of Test Circle Contents	Triclosan (present or absent)
Urine from Child 1 who used antimicrobial products containing Triclosan		
Urine from Child 2 who did NOT use antimicrobial products containing Triclosan		
Positive Control Contains Triclosan		
Negative Control Does NOT contain Triclosan		

5. What color indicates that Triclosan is present in a sample? _____

Write the name of the sample that you looked at to arrive at your answer. _____

6. What color indicates that Triclosan is not present in a sample? _____

Write the name of the sample that you looked at to arrive at your answer. _____

7. Look back at your prediction in Part 2 question 1. Was your prediction correct? If not, how do the test results differ from your prediction?

Exposure to Triclosan

Triclosan exposure has become so common that it has shown up in the urine of people throughout the world. While people who use Triclosan products daily have higher levels of the chemical in their bodies, even people who do not use Triclosan on their skin are exposed to it through food, water, and even household dust. Triclosan may be absorbed through the skin, ingested when it is present in food and water that people drink, or inhaled in dust particles.

8. Explain how Triclosan could get into people who did not use products that contain Triclosan.

Is Triclosan Safe?

In 2008, the US Environmental Protection Agency (EPA) conducted a risk assessment using the results of available research that studied the effects of Triclosan on animals. Based on the results of these animal studies, the EPA determined that antimicrobial products containing Triclosan are safe and unlikely to cause health problems.

However, since the 2008 risk assessment, additional data from animal research has shown that Triclosan interferes with the function of the endocrine system (such as thyroid hormones and estrogen hormones). Research also indicates that Triclosan disrupts the function of the immune system and the reproductive system in animals.

Research is now being done to determine if Triclosan has similar effects on human health. The EPA plans to use data from research on humans to determine if Triclosan is safe and effective for human use.

9. Based on the data from animal research studies, list three human body systems that may be affected by Triclosan.

- _____
- _____
- _____

10. What is one potential benefit of Triclosan use?

11. What is one potential risk of Triclosan use?

12. Until the EPA completes its scientific investigation on Triclosan safety, what steps could people take to minimize their Triclosan exposure?

Part 3: Antimicrobials and “Superbugs”

Antimicrobials and Superbugs

Scientists are concerned that overuse of antimicrobial substances is causing the evolution of “superbugs”—bacteria that are resistant to antimicrobial substances such as Triclosan or antibiotics. Resistant bacteria can survive and reproduce when exposed to antimicrobial substances.

Without the protection offered by antimicrobials, people could die from infections that are usually prevented or treated by using antimicrobials. A simple scrape to the skin, a case of pneumonia, childbirth, surgery, and other medical procedures would become dangerous.

1. What do scientists mean when they talk about “superbugs”?

2. If bacteria evolve to become resistant to antimicrobials, what effect would this have on humans?

How do bacteria evolve to become “superbugs” that are resistant to antimicrobials such as Triclosan? You will use the contents of the bag labeled “For Part 3” to model the evolution of bacteria that are resistant to Triclosan.

3. Use the clear plastic dish labeled **Environment for Bacteria** to represent the bacteria’s environment—a human body, water, or soil.
4. Empty the contents of the bag labeled **Bacteria Before Exposure to Triclosan** into the clear plastic dish. This bag contains assorted colors of beads representing different types of bacteria in the environment.



5. Random mutations (changes in the DNA code in genes) have resulted in **variation** in the bacteria.

- The variation in bacteria is represented by the different colors of beads. How many different varieties of bacteria (colors of beads) are present in the environment (clear plastic dish)? _____
- What caused the variation in the bacteria?

6. Model the introduction of Triclosan into the bacteria's environment. Place the plastic dish on top of the blue colored circle labeled **Triclosan added to environment**.

7. Beads that are not red represent bacteria that are susceptible to (killed by) Triclosan. Remove all beads that are not red from the plastic dish. Return these beads to the **Bacteria Before Exposure to Triclosan** bag.

Red beads = bacteria that have a mutation that makes them resistant to Triclosan

Other colors of beads = bacteria that do not have a mutation that makes them resistant to Triclosan.

8. Beads that are red represent bacteria that have a mutation that makes them resistant to Triclosan. They can survive when Triclosan is present in their environment. Model this by leaving all of the red beads in the plastic dish.

9. Which statement below is correct? (circle one)

Triclosan caused the mutation for Triclosan resistance.

OR

The mutation for Triclosan resistance was there before the bacteria were exposed to Triclosan.

10. The red beads that remain in the plastic dish represent bacteria that are resistant to Triclosan. These Triclosan-resistant bacteria survive and reproduce to produce more Triclosan-resistant bacteria. Add the red beads from the **Other Beads** bag to the dish to represent the Triclosan-resistant bacteria that result from reproduction of the surviving bacteria.

Evolution by natural selection results when organisms in a population have a beneficial genetic trait that makes them better able to survive and reproduce in an environment. Natural selection leads to an increase in the proportion of individuals in future generations that have the beneficial trait and to a decrease in the proportion of individuals that do not have the beneficial trait.

11. Evolution by natural selection results when organisms in a population have a beneficial genetic trait that makes them better able to survive and reproduce in an environment. What is the beneficial genetic (inherited) trait that is represented in the bead model?

12. Natural selection leads to an increase in the proportion of individuals in future generations that have the beneficial trait and to a decrease in the proportion of individuals that do not have the beneficial trait.

- What happens to the proportion of bacteria that have the beneficial trait?

- What happens to the proportion of bacteria that do not have the beneficial trait?

13. Triclosan is considered a “natural selection agent.” How does Triclosan act as a selecting agent?

NOTE: Put five of the red beads back into the bag labeled “Bacteria Before Exposure to Triclosan.” Return the remaining ten red beads to the bag labeled “Other Beads.”

14. Your lab kit contains a colored sheet – **Evolution of Antibiotic Resistant Bacteria**. Cut along the dotted lines to create a set of diagram cards and a set of caption cards.
15. Match each of the diagram cards with the appropriate caption card.
16. Arrange the diagram cards and caption cards in the proper order to illustrate the natural selection process that leads to the evolution of antibiotic resistant bacteria.
17. Write letters for the correct order of the diagram cards and caption cards below.

Diagram Card Letters: _____
Caption Card Numbers: _____

18. The following statements represent **misconceptions** that people have about antibiotic resistance. Each of the following statements is false (a misconception). Correct each statement so that it is true.

Misconception:
a false or incorrect view, opinion, or attitude

- a) Misconception 1: People are becoming resistant to antibiotics.

- b) Misconception 2: Antibiotics cause mutations that make bacteria resistant to antibiotics.

- c) Misconception 3: Antibiotics are getting weaker because we overuse antibiotics for humans and farm animals.

- d) Misconception 4: Evolution is not happening today. It only happened in the distant past.

19. What do YOU think? Do you think the benefits of Triclosan use are greater than the risks of Triclosan use? Support your answer with at least 4 pieces of evidence from Part 1 through Part 3.
