Who Killed the Flowers?

Teacher Information

Summary:

Mrs. Powell, the science teacher, suspects that someone killed some flowers in the school's greenhouse by urinating on them. In this science lab, students will test artificial urine made from ammonia, vinegar, and food coloring to identify the culprit who urinated on some flowers in the school's greenhouse.

Objectives:

- Students will conduct various tests on known urine samples to identify characteristics of urine.

- Students will identify the owner of an unknown, artificial urine sample.

Materials Needed:

1. Container
2. Five test tubes for each student or group of students
3. Test tube rack for each group
4. Grease pencil or masking tape for labeling the test tubes
5. Food coloring
6. Distilled water
7. Vinegar
8. Ammonia
9. Yeast
10. Apple juice
11. pH strips and color chart
12. Glucose strips with color chart or Benedict's solution.

Procedure:

1. Read the background information to your students and then have them read "The Crime".

2. Copy a Student Investigator Page for each student or for each group of students. This activity is most effective if done in groups of 2 or 3 students.

3. Prepare five 1-liter containers of artificial urine. Label each container with the following names: Jacob, Bob, William, Mike, and Flower Pot.

Name_____ Date_____

4. To prepare the urine, pour 1 liter of distilled water into each container. Add the following ingredients to each container:

    - Jacob's urine: Add enough vinegar to make the pH lower than 5, and add enough yellow food coloring to make the sample yellow.

    - Bob's urine: Add enough yellow food coloring to make the same yellow and add enough ammonia to raise the pH to 7.1 or slightly higher.

    - William's urine: Add enough green food coloring to make the sample a very pale green and a few spoonfuls of apple juice to provide a positive glucose test. Adjust the pH to about 6 by adding vinegar. Stir in some yeast cells to make the urine cloudy. After adding the yeast, check the pH level to be sure it hasn't changed.

    - Mike's urine: Add enough green to get the same color as William's urine. Add enough ammonia to make the pH level 8. Add enough yeast to this sample to make it as cloudy as William's urine.

    - Flower pot urine: This sample should be exactly the same as William's urine.

5. You can test for glucose using one of these two methods:

    - The easiest, but most expensive way is to use glucose test strips, which can be bought at a pharmacy or a science supply company.
    - The cheaper, but more complex way, is to add 10 drops of Benedict's solution to the urine sample in a test tube. Heat the test tube in a hot water bath for about 3 minutes.

        Use the following guidelines for results:
        - Blue-- no sugar
        - Green—trace of sugar
        - Yellow—1 to 2% of the urine contains sugar
        - Orange or red—more than 2%

Name_____ Date_____

Background Information:

During a criminal investigation, urine can be a source of important information. Urine discovered at a crime scene might provide some useful evidence. Because the chemicals in urine can vary from one individual to another, a person's urine can be unique enough to positively identify a suspect.

There are a variety of tests that can be performed to determine some of the characteristics of a urine sample. Three basic tests are:

1. The first thing to consider when comparing urine samples is the visual observation of color and transparency. Urine can have a variety of colors, ranging from colorless to amber. Urine color is related to the substances in urine. Some diseases can cause different colors, too. Red or brown may indicate the presence of blood. Diabetics may have pale green urine. The transparency of urine varies from one person to the next. Most urine is clear, but cloudy urine can result from normal bacteria or from abnormal pus in the urine.

2. Determining the pH level of urine is another important test. Urine pH usually ranges from 4.7 to 8.0. Most urine is acidic, that is, it has a pH of less than 7. The pH of urine varies with the time of day, kinds of food consumed, and amount of water consumed. It can also be influenced by stress, fatigue, and rate of respiration. In the morning, urine is usually very acidic because of the buildup of carbon dioxide in the system. A lot of protein in the diet also causes urine to be acidic. Eating veggies may cause urine to be alkaline, that is, a pH above 7.

3. A third basic test measures the presence of glucose in the urine. Glucose, which is blood sugar, can appear in the urine of people with diabetes. Diabetics have problems with insulin, a chemical in the body that helps it use glucose. You get energy from the break down of glucose in your cells. In diabetics, glucose cannot be taken from the blood into the cells where it is needed. Instead, it travels in the blood until it reaches the kidneys, where it is removed and expelled into the urine. Diabetics who are not under constant treatment have glucose in their urine. A diet high in sugar can temporarily cause glucose to appear in anyone's urine.

Name_____ Date_____

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Student Information Sheet

The Crime:

Mrs. Powell, the science teacher, just loves growing plants and flowers. She has flowers everywhere - in her classroom and in the school's greenhouse. She wants all of her students to enjoy the outdoors as much as possible. Students are constantly surrounded by her pretty flowers. Unfortunately though, for the last two weeks, some of the flowers in the greenhouse have been dying. Mrs. Powell couldn't figure out what was happening, but she suspected that some of the students may be ruining the flowers.

Mrs. Powell assigns four students a week to care for the plants and flowers in the greenhouse. For the last two weeks, six different boys have been responsible for caring for the flowers and plants.

Early this morning, after two of the boys should have been in to water, Mrs. Powell made an interesting discovery. As she opened the door and walked through the greenhouse, she noticed an unusual smell. Looking around the greenhouse, she discovered a yellow liquid in the bottom of one of the flower pots. Suddenly she recognized the smell and realized that someone had urinated in the flower pot.

Mrs. Powell questioned four of the boys, but no one admitted to the dirty deed. She checked the list of names of the other helpers and found that all four of these boys had been in the greenhouse at various times during the past two weeks. She felt sure that one of them was her flower killer.

Mrs. Powell had an idea that might help solve this mystery. She called the school nurse in to help her. The nurse agreed, and asked all four boys to give her a urine sample in a paper cup. She also collected urine from the flower pot, and poured it into another paper cup.

Your job is to help Mrs. Powell figure out who urinated in the greenhouse flowers.

Name_____ Date_____

Procedure:

1) Label the five test tubes as:

   J for Jacob's urine
   B for Bob's urine
   W for William's urine
   M for Mike's urine
   FP for the flower pot urine.

2) Place 10mm of each urine sample in the appropriate test tube. Set the five tubes in the test tube rack.

3) Hold a piece of white paper behind each of the five test tubes. In the Data Table, record the color of each sample. (Possible colors could include colorless, bright yellow, dark yellow, amber, yellow-orange, pale green, black, brown, or red). Also note and record the transparency (clarity) of each sample. (Transparencies include clear, slightly cloudy, very cloudy, and opaque).

4) Dip a strip of pH paper into test tube J. Once it has air dried for 10 seconds, compare the color of the paper with the color chart. On the Data Table, indicate the pH of the urine. Repeat this step for the other four samples.

5) Test the urine samples for the presence of sugar by dipping a glucose test strip into each test tube. Consult the bottle or package that the test strips came in to interpret your results. Record these in the Data Table. If no glucose is present, write "negative" in the Data Table. (If glucose test strips are not available, ask your teacher for another procedure to test for glucose.)

Name_____ Date_____

Data Table

Results on Urine Samples

Sample	*Color and transparency*	*pH*	*Presence of Glucose*
Jacob			
Bob			
William			
Mike			
Flower Pot			

Name_____ Date_____

Questions

1) Who was the criminal? How do you know? Explain your answer.

2) Name the suspects who had acidic urine.

3) Name the suspects who had glucose in their urine. Does this mean they were diabetics? Why or why not? Explain your answer.

4) In at least one or two paragraphs, write a conclusion to this story. Name your criminal and the evidence you have against him. Describe how you will present this case to the parents of the accused suspect.

Name_____ Date_____

Answers

1) William; his urine generated the same test results as the flower pot urine.

2) Jacob and William.

3) William; no; glucose can appear in urine after someone has eaten a lot of sugar.

4) Answers will vary.