NAME _____

DATE _____

Trace Powder Evidence Inquiry Kit

Background

Medical diagnostics teams specialize in determining the identity of diseases and disorders in patients. They collect information about vital signs, symptoms, exposures, lifestyle, and genetic history. Other medical professionals, such as physicians, physician's assistants, nurses and medical technicians may perform similar tasks as part of their jobs. Similar to forensic scientists, medical diagnosticians may work in labs, comparing samples of known materials and substances to evidence found at the scene of an incident, all to help answer questions about the patient's condition.

When comparing found evidence to known samples, four different outcomes can result:

1. **Complete match.** The samples match in every conceivable way and can provide evidence strongly suggesting a certain aspect of the incident—a specific suspect, material, or location, for example.
2. **No match.** The samples in no way match. In this case, certain bits of information may be discounted from the investigation.
3. **Partial match.** The samples share some, but not all, characteristics. Depending on the type of evidence and the situation, a partial match may lead to further (and perhaps more specific) investigation.
4. **Inconclusive.** The evidence provides insufficient information to make a meaningful comparison. The evidence provides no additional information applicable to the investigation.

The role of a medical diagnostician is often challenging, because physical evidence can be difficult to collect, analyze, and interpret. The disease may be rare or one or more of the patient's symptoms may not be related to the same disorder. When analyzing samples, the evidence may not match the known examples at all. This career involves solving a series of puzzles and relies heavily on critical thinking and problem-solving skills.

Medical practitioners and other scientists often use microscopes to explore the structure and properties of materials. Broadly, microscopy is the investigative practice of using tools to observe objects that are too small to be viewed by the unaided eye. The tool might be a simple handheld magnifying glass or a complex research instrument worth millions of dollars. The magnifying power of most compound microscopes ranges from 20× (twenty times) to 400× (four hundred times). In the following activity, you will focus on microscope techniques to solve a medical case.

The Scenario: Cindy's Case

You are members of a medical diagnostics team at Pearson Hillsboro Hospital. Cindy, a two-year-old girl, was rushed to the Emergency Room. Cindy's babysitter, Lisa, says that Cindy tore through the kitchen while she was in the bathroom. Cindy opened cupboards and drawers, leaving the kitchen littered with food and dusted with an unidentified powder. Lisa fears that Cindy might have gotten into the cleaning supplies under the sink. Cindy is in serious trouble.

Condition:

9:15 a.m. Cindy displays a bumpy rash and swelling around her mouth.

9:45 a.m. Cindy exhibits increased swelling, has difficulty breathing, and experiences a drop in blood pressure.

What did Cindy eat that would cause these symptoms? Use literary resources, your microscopes, and your powers of problem-solving to help Cindy.

Activity 1: Known Slide Observations

During this exercise, you will practice microscopy techniques. You will observe various microscope slides, create diagrams, and write detailed descriptions of what you see.

Materials

compound microscope
Trace Powder Evidence Slides
pencil
Data Sheet

Procedure

1. View the slide at each microscope station.
2. Using your pencil, draw what you see in each field of view and record it in the appropriate place on your Data Sheet. Label any structures that you recognize. Examine the image under two magnifications and record them on your Data Sheet. When figuring the total magnification of the sample, multiply the power of the ocular lens by the power of the objective lens.
3. Record your observation notes for each slide, describing properties of the sample such as size, shape, color, and texture. Is the sample crystalline? Was the specimen living at one time? If you can see cells, do they have a nucleus?
4. Make your way around to all eight microscope stations. Repeat the observation and documentation steps at each station. Make sure your recorded notes correspond with the correct station number and slide.

Activity 2: Microscope Investigation

During this exercise you will prepare your own slides from the powder found around Cindy's mouth. You will compare this slide with your observations and descriptions of the slides in Activity 1 and then hypothesize as to the identity of the evidence powder.

Materials

compound microscope
pencil
cup with evidence powder
cup of water
toothpick
slide
coverslip

Procedure

1. Moisten the end of a toothpick by dipping it into the cup of water. The tip should be wet but not dripping.
2. Place the moist toothpick into the cup of evidence powder. The powder will stick to the toothpick.
3. Place the sample on the slide by rolling the toothpick with the evidence powder onto the center of the glass slide. Avoid piling the powder on the slide.

4. Gently place the coverslip over the powder in order to keep the sample in place and to keep contaminants out.
5. Examine your slide at two magnifications and record your findings on your Data Sheet under Evidence Powder Observation.
6. Use your observations to answer the questions in the Activity 2 Report.

Activity 3: Physical Tests, Literature Research, and Conclusion

At this point, you should have the identity of the evidence powder narrowed down to one or two options. Keep in mind that our database of known powders contains only eight samples. In a real-life situation, there could be thousands of possibilities. Before jumping to conclusions, more evidence is need for Cindy's diagnosis and treatment. This is your team's chance to shine.

Consider everything you know about these substances. Many of these powders are found in a kitchen and are present in our everyday lives. What other physical properties of the evidence powder can you investigate? Properties of matter not observable by microscope include hardness, malleability, ductility, melting point, boiling point, crystal formation, solubility, odor, viscosity, vapor pressure, temperature, and density. Because of safety concerns, tasting the evidence powder is **not** an option.

Procedure

Activity 3 Plan

Apply what you already know along with the new evidence to support or confirm the hypothesis you presented in Activity 2. Perform at least two tests to give you more information about the evidence powder. Remember, the test does not have to be complicated. Before conducting your tests, fill out the Activity 3 Plan for Test 1 and Test 2 on your Data Sheet. Before you begin, review the test idea and the materials you need with your instructor. Get your instructor's approval before you continue with your tests.

The following is an example of a complete Activity 3 Plan.

Test 1:
What are you testing?

We are testing the solubility of the evidence powder in water.

What materials will you need?

We need 1 gram of uncontaminated evidence powder, 5 mL of water in a clean clear cup or test tube, a spoon for stirring, a scoop, weigh paper, and a scale.

Describe the steps of your test:

1) *One team member will weigh 0.2 grams of powder*
2) *A second team member will add the powder to a cup/tube with 2 mL of water.*
3) *A third team member will stir powder into water.*
4) *All team members will make observations of color. Is the solution clear or opaque?*
5) *Steps 1–4 will be repeated until powder can no longer be mixed into solution. Powder sits on the bottom even after repeated stirring.*
6) *We will calculate the quantity of powder (in grams) that can be dissolved into 2 mL.*
7) *If we have time, we will repeat the experiment.*

Teacher's Initials for Approval: ***Approved***

Tip: To prepare a wet mount slide of the evidence, place a small amount of powder on a clean slide as in Activity 2. Then, use a transfer pipet to add a drop of water to the powder. Lay one edge of a coverslip down on the slide so that it touches the water drop and then slowly lower the rest of the coverslip down over the sample, allowing gravity to squeeze out any remaining bubbles.

Activity 3 Report

Physical Tests

After you have performed the tests, answer questions 1–3 in the Activity 3 Report section of your Data Sheet.

Literature Research

Do your own research on physical properties of the evidence powder to support or refute your hypothesis. Use at least two sources. Answer the relevant questions in the Activity 3 Report.

Continue your literature research to make a connection between Cindy's symptoms and the evidence powder. Follow your instructor's guidelines for available tools for your research. Use at least two research sources. Answer the relevant questions in the Activity 3 Report.

Conclusion

Answer Question 8 in the Activity 3 Report.