(g) Two changes in the procedure that might improve band separation include allowing the chalk to sit in the water for a longer period of time, and using a thinner ring of ink.

REFLECT ON YOUR LEARNING

(Page 7)

1. Some physical properties that may be used to identify matter include colour, odour, texture, boiling point, melting point, and conductivity. Some chemical properties that may be used to identify matter include behaviour in an acidic or alkaline environment.
2. Models are important in science because they allow scientists to communicate their ideas to other scientists. Models help scientists conceptualize, simplify, and/or clarify ideas. When coming up with models, scientists must think through their ideas and test them before presenting them to others.
3. Some careers in which people need to identify matter include forensics, environmental science, and chemistry. Forensic scientists examine crime scenes to find and analyze evidence from a crime scene for use in law enforcement. Environmental technicians test water samples to detect the presence of contaminants. Chemists need to identify different substances produced in a laboratory setting.

1.1 ACTIVITY: IDENTIFYING A MYSTERY POWDER

(Pages 8–9)

Observations

Student answers will vary depending on the powders chosen by the teacher. If the powders suggested in this teacher's resource are used, the following observations will be made.

Table 1

Powder	Appearance
(1) Aspirin	white crystalline powder, slightly yellow tint
(2) powdered sugar	fine white powder, becomes matted easily when touched
(3) sodium dihydrogen phosphate	fine white powder
(4) buffered Aspirin	fine white powder
(5) baking soda	very fine white powder, does not become matted when touched
(6) sodium monohydrogen phosphate	fine white powder

Table 2

	Aspirin	Powdered sugar	Sodium dihydrogen phosphate	Buffered Aspirin	Baking soda	Sodium monohydrogen phosphate
water	insoluble	soluble	soluble	insoluble	soluble	soluble
universal indicator	acidic	neutral	acidic	acidic	basic	basic
$HCl_{(aq)}$	no reaction	no reaction	no reaction	gas released	gas released	no reaction
$Fe(NO_3)_{3(aq)}$	brownish-purple	no reaction	no reaction	brownish-purple	no reaction	no reaction
$I_{2(aq)}$	blue-black	no reaction	no reaction	blue-black	no reaction	no reaction

Student answers in **Table 3** will vary depending on which of the six powders the teacher chooses to be the mystery powder. If buffered Aspirin is provided, the observations will be as follows (on page 8).

Table 3 Mystery powder

Test	Results
water	insoluble
universal indicator	acidic
$HCl_{(aq)}$	gas released
$Fe(NO_3)_{3(aq)}$	brownish-purple
$I_{2(aq)}$	blue-black

Analysis

(a) Student answers will vary depending on the sample provided. The mystery powder is buffered Aspirin.
(b) The physical properties that were tested were solubility in water and pH.
(c) The chemical properties that were tested were the possible reactions between the sample and hydrochloric acid, iron(III) nitrate solution, and iodine solution, respectively.
(d) It was important to test the six samples first in order to learn about the properties of each powder. When the mystery powder was tested in the same way as the other six powders, it could be identified by comparing its properties to those of the other powders.
(e) Qualitative analysis was performed in this activity. Qualitative analysis involves the identification of a sample of matter based on its physical and chemical properties and comparing these properties to the properties of known substances. In this activity, a mystery powder was subjected to five different tests. The results of these tests were compared to the results of tests on six identified powders, enabling the student to identify the mystery powder.

Evaluation

(f) Student answers will vary depending on experience. In general, students should be quite confident given that they have performed five different tests on the mystery powder. Alternatively, if procedural errors have been made, students may not be able to conclusively identify their unknown.
(g) Additional tests that may be performed could include investigating the boiling point, melting point, and reactions with other solvents, such as ethanol.
(h) A source of error in this activity could be the small quantities of each of the powders used, making it difficult to detect physical and chemical changes. This source of error could be reduced by repeating the experiment or conducting it using larger quantities of powders. Cross-contamination is another possible source of error. To reduce this source of error, students could use a different toothpick for each well in the microtray.
(i) In many instances, forensic scientists are called to crime scenes to clarify the identity or origin of "evidence." For example, a forensic scientist specializing in arson could be asked to examine the damage caused by the fire, to determine whether an accelerant was used, and, if so, to identify it. Another example is a ballistics expert, who may examine gun residue to determine the type of gun used to commit a crime.

1.2 BUILDING SCIENTIFIC KNOWLEDGE

TRY THIS ACTIVITY: THE BURNING CANDLE

(Page 11)

(a) Student answers will vary. Some examples of statements that may be made are: The flame of the candle is orange. The heat from the flame melts the candle wax. The candle was reduced in size by 20 mm. The flame of the candle is hot. The flame of the candle flickers. Melted wax runs down the side of the candle. As the hot liquid wax cools, it becomes solid.
(b) Student answers will vary. The statements provided in (a) may be classified as follows:
Observation: The flame of the candle is orange. The candle was reduced in size by 20 mm. The flame of the candle flickers. The flame of the candle is hot.
Inference: Melted wax runs down the side of the candle. The heat from the flame melts the candle wax. As the hot liquid wax cools, it becomes solid.
(c) Student answers will vary. In (b) above, there are equal numbers of inferences and observations.
(d) (i) Observation: The patient's temperature is 39.8°C.
Inference: The patient has a high fever.