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

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(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.

(ii) Observation: The back wall of the bedroom is completely burned.
Inference: The fire started in the mattress from careless smoking.
(iii) Observation: The soup is very spicy.
Inference: Chili peppers must be one of the ingredients in the soup.

SECTION 1.2 QUESTIONS

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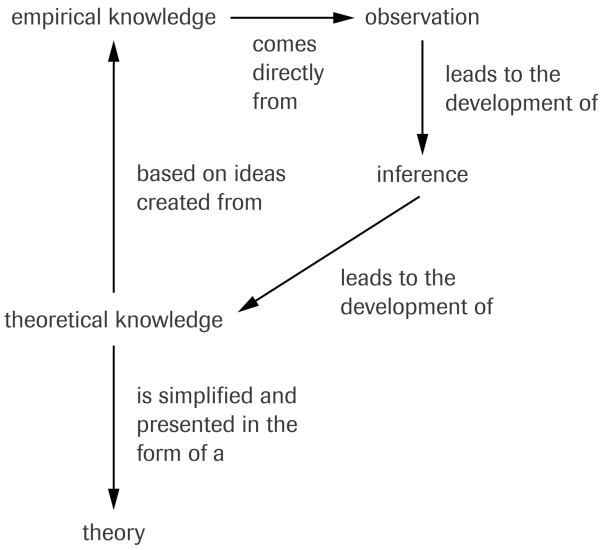
Understanding Concepts

1. (a) inference
   (b) observation
   (c) observation
   (d) inference
   (e) observation
2. A theory is an explanation of a large number of related observations. To come up with a theory, scientists must use their imaginations as well as empirical evidence collected from experiments. Even though a theory is grounded in observation, since it is an idea, it cannot be proven. Many theories are accepted as true, however, since a large amount of experimental evidence supports them. The more experimental testing a theory can withstand, the more credible it becomes.
3. Models can help convey an idea or a concept. A model is a visualization of a theory. Scientists use models to help describe and explore their ideas.

Making Connections

4. 

5. In a court of law, the prosecution and the defence are both interested in only the presentation of facts. If witnesses make inferences, they are considered to be offering an opinion, which could sway a judge or jury. Also, the opinion may be invalid because witnesses may be misinterpreting what they observed. Unless the witness is an "expert," then opinions are struck from court records.
6. Qualitative analysis is empirical because it is based on the physical and chemical properties of substances. Scientists compare the physical and chemical properties of an unidentified sample of matter to those of already identified substances in order to identify the unknown.

1.3 EARLY MODELS OF THE ATOM

TRY THIS ACTIVITY: AN ANALOGY TO PROBING THE ATOM

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(a) Student answers will vary depending on the object encased in the Plasticine. Student descriptions will focus on physical properties, such as the object's size and shape. Students may also speculate on what the object is made of,