

Teacher Guide

Pigments Identification Activity

Introduction:

Paint consists of a binder, such as oil, resin or gum, mixed with a colorant. Throughout history painters have used a wide variety of organic and inorganic substances to produce color in their work. Inorganic colorants are typically finely ground powders called pigments. In addition to their colors, pigments have unique properties such as particle size, shape, and translucency; solubility; or reactivity to temperature changes and pH. These physical and chemical properties can be examined to distinguish pigments. Since some pigments are characteristic of certain time periods, pigment identification can help with dating and verification. Because pigments react and age differently, identifying the pigments present may influence decisions about the conservation treatment of a painting or painted object. In this activity, students will use microscopy and chemical spot tests to identify a set of blue pigments.

Objectives:

- Make qualitative observations of unknown pigments.
- Use chemical tests to identify unknown pigments.
- Use microscopy to identify unknown pigments.

9-12th grade Science Georgia Performance Standards:

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

- a. Follow correct procedures for use of scientific apparatus.
- b. Demonstrate appropriate techniques in all laboratory situations.
- c. Follow correct protocol for identifying and reporting safety problems and violations

SCSh3 Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data.
- f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SC1 Students will analyze the nature of matter and its classifications.

- b. Identify substances based on chemical and physical properties

Supplies (per group):

Pigments: I. Verdigris*
II. Prussian Blue
III. Cobalt Turquoise
IV. Egyptian Blue

Microscope
Microscope slides
Cover slips
Microspatula
Distilled water
8 Test tubes (small)
Droppers or pipets
Bunsen burner or short (votive) candles
Matches or lighter
Hydrochloric acid (HCl), 10%
Sodium hydroxide (NaOH), 5%

Safety: HCl and NaOH are corrosive. Minimize contact with skin. Wear gloves and goggles.

Teacher Pre-Lab:

- Pigments can be purchased from suppliers of historic pigments, such as Kremer Pigments (www.kremerpigments.com) or Natural Pigments (www.naturalpigments.com)
- Verdigris can be produced using copper and acetic acid, as described in the *Corrosion and Copper Activity*
- Label jars of pigments I-IV. Do not allow students to know historic names.
- **Note:** This lab can also be used to identify a single unknown pigment.

Procedure:

Note: Be sure to demonstrate to the students, the very small (tiny) amount of the pigment required to complete each part of the lab.

Microscopy:

1. Obtain 4 microscope slides and covers. Label your slides I, II, III, and IV.
2. Using the tip of a microspatula, take a tiny amount of Pigment I for your first slide. Place a few crystals of the pigment in the center of the slide. Add 1 small drop of distilled water to the slide and then cover. Be careful not to add too much water.
3. Repeat Step 2 for Pigments II, III, and IV.
4. View your prepared slides under the microscope. Observe. For each pigment, take note of its relative particle size, shapes, color, uniformity, and degree of transparency.

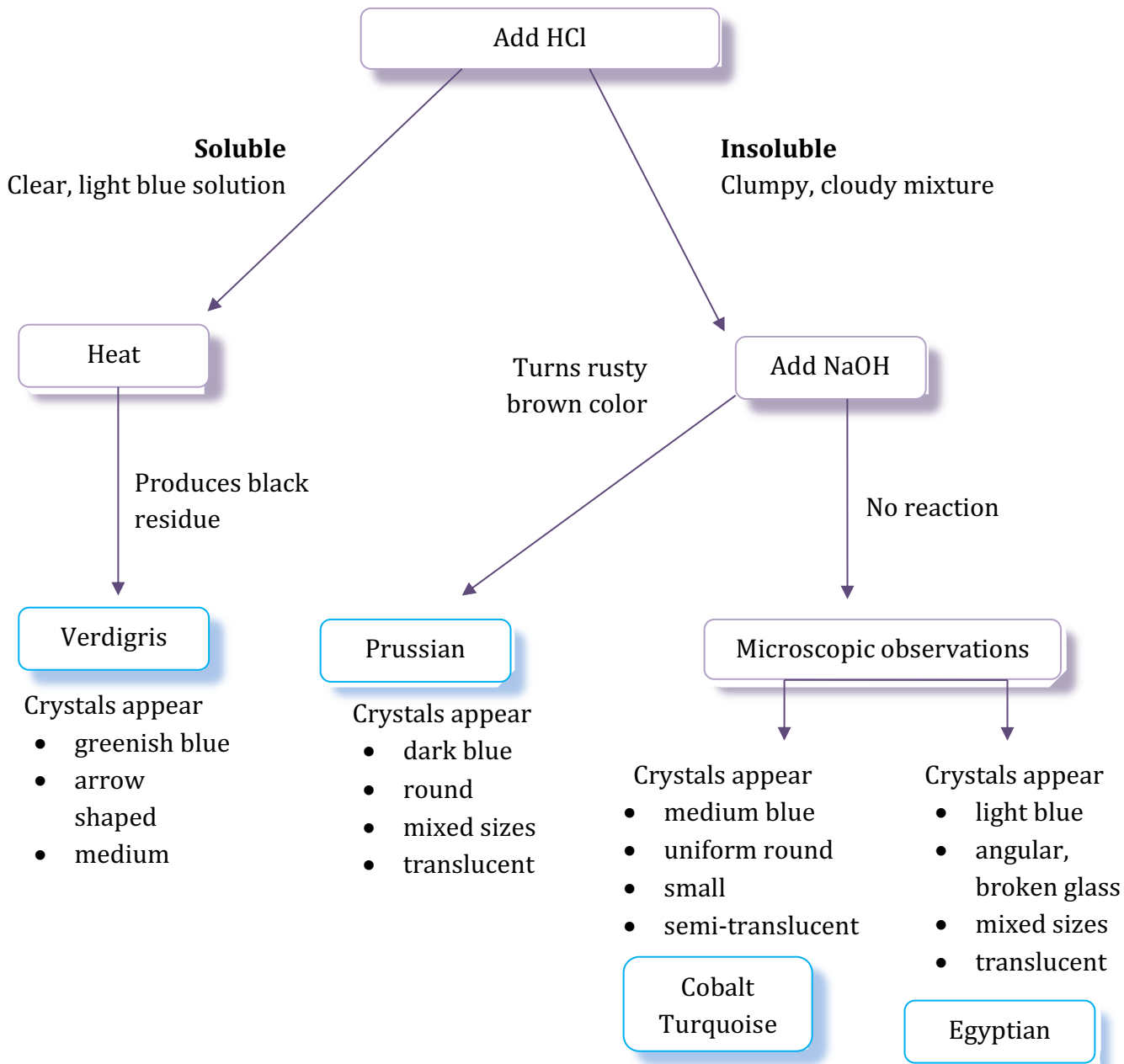
Chemical Tests:

1. Obtain 8 small test tubes. Label the test tubes I, II, III, and IV. Each pigment will require 2 tests, so you will need two tubes for each number.
2. Using the tip of a microspatula, place a tiny amount of Pigment I into your first test tube. You need only a few particles; You do not need to cover the bottom of the test tube.
3. Repeat Step 2 with Pigments II, III, and IV and their respective test tubes.
4. In each of these 4 tubes, add 3 drops of the dilute HCl. Swirl each tube to mix and allow mixture to settle. Observe and record the characteristics of each mixture. View against white background. Acid soluble pigments will dissolve and appear as a homogenous colored solution. Acid insoluble pigments will settle at the bottom of the tube in a clumpy, cloudy mixture.
5. Using the tip of a microspatula, place a tiny amount of Pigment I into one of your remaining test tubes.
6. Repeat Step 5 with Pigments II, III, and IV.
7. If the pigment was soluble in acid in Step 4, test its second sample in heat. Using tongs, hold the test tube over a Bunsen burner or candle flame for about 5 minutes. Once cooled, wipe exterior of test tube to remove soot, etc. Observe and record color changes.
8. If the pigment was insoluble in acid in Step 4, test its second sample with NaOH. Add 3 drops of the dilute NaOH to the test tube. Swirl each tube to mix and wait about 2 minute for reaction. Observe and record color changes.
9. Using your observations and the pigment identification chart provided, determine the identities of Pigments I, II, III, and IV.

Clean up:

The contents of the test tubes with NaOH and HCl should be disposed of in the proper containers.

Pigment Identification Flow Chart



Selected Resources:

- Pigments Throughout the Ages <http://www.webexhibits.org/pigments>
- Gettens, R. J., & Stout, G. L. (1966). *Painting Materials: A Short Encyclopaedia*. Courier Dover Publications.
- Scott, D. A., Dennis, M., Khandekar, N., Keeney, J., Carson, D., & Dodd, L. S. (2003). An Egyptian Cartonnage of the Graeco-Roman Period: Examination and Discoveries. *Studies in Conservation*, 48(1), 41–56.