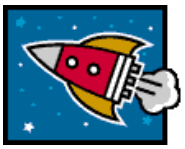


# Analyzing Planetary Surface Samples

**Background:** Examining the surface material of a planet can give you valuable information relating to the organic and inorganic materials that may have been part of the geological and biological makeup of the planet. In this activity, teams will examine a simulated sample taken from their testing site on the strange, new planet. By separating and analyzing the components of this sample, they will make several theories about how these components support their hypothesis as to the activity that might have occurred on the planet, in the past, on this site.

**Goal:** Students will analyze a surface sample to develop a theory about the geological and biological history of the planet.

**Objectives:** Students will…

- Classify and group components of the Planetary surface sample
- Examine each group using magnification
- Test reactions of each group to water, acid, heat, and magnetism
- Use a Dichotomous Key to identify the unknown Planetary samples
- Develop a theory from their observations

**Materials (for a class of 20 working in groups of 4):**

- 10 tweezers
- 5 small metal spatulas
- 5 alcohol burners with alcohol or 6 butane lighter torches
- 5 small beakers (50 ml) for water
- 10 chemplates (SEPUP trays)
- 5 pieces of white paper
- 5 sheets of aluminum foil or 6 aluminum trays
- Matches (instructor should control these)
- 20 safety glasses
- 5 magnets
- 10 magnifiers
- 5 stop watches
- 5 dropper bottles of 6 M HCl
- 20 copies of Analyzing Planetary Surface Samples-Student Sheet
- 20 copies of Analyzing Planetary Surface Samples-Student Direction Sheet
- 20 copies of Analyzing Planetary Surface Samples-Table 1
- 5 droppers or plastic bulb pipettes
- 5 small sample containers each with at least 4 pieces of: (*see Teacher Ordering Sheet for additional information)
    - lead balls (shot)
    - black snakes (4$^{th}$ of July)
    - copper balls (shot)
    - aluminum balls (shot)
    - copper sulfate pieces

- magnesium strips
- diaper crystals
- iron shavings
- small pebbles
- small shell pieces (oyster shell works well)
- crushed sparkles – not the wire (4th of July)
- chips of Alka-Seltzer™

**Time Required:** 45-60 minute period

**Standards Met:** S1, S2, S3, S4

**Procedure:**

PREP

- If students collected samples earlier in the unit, use these samples for this lab. If students did not do this activity, prepare the planetary soil samples (5 per class and labeled for the sites 1, 2, and 3) that the students will be using. See equipment list above. You can prepare different samples for each of the locations (1, 2, or 3) or make the same sample for all locations and see how each group interprets the results in relation to their hypothesis.

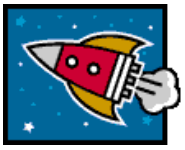
IN CLASS

- Review the information found in the background to this lesson plan.
- Ask students to work in mission teams.
- Safety Note: Students will be working with an open flame during this lab and some of the materials may be combustible. Monitor the classroom carefully. Safety glasses should be worn at all times during the lab! Melting/burning materials, such as lead shot, should always be conducted under a functioning fume hood.
- Give each student a copy of Analyzing Planetary Surface Samples-Student Direction Sheet. Review the process students will use throughout the lab. Stress safety.
- Give each mission team several sheets of white paper, safety glasses, magnifying glass, tweezers, magnet, and metal spatulas.
- Give each mission team a sample from sites 1, 2, or 3. Be sure they note which site their sample comes from Analyzing Planetary Surface Samples-Table 1.
- Remind students to put on their safety glasses.
- Students should complete the first seven steps on their direction sheets.
- Give each mission team a beaker, dropper, and a Chemplate (SEPUP tray).
- Students should follow steps 8-13 on their Analyzing Planetary Surface Samples-Student Direction Sheet.
- Review with the class how to use the alcohol burner or butane torch and safety issues (use of fume hood).
- Give each mission team an alcohol burner (butane torch), aluminum foil or tray, and a stopwatch.
- When teams are ready, light their alcohol burners/torches for them.
- Students should proceed to directions 14-19, they can take turns using the fume hood when melting objects.

- Have the students extinguish their burners and collect the alcohol burners/torches.
- Students should complete the rest of the directions.
- Hand out the Analyzing Planetary Surface Samples-Student Sheets and allow students to proceed to answer the questions.

**Assessment:**

- Completed student sheet
- Participation in the lab



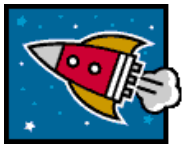
# Teacher Ordering Sheet

Below is a complete list of ordering information for the samples needed in this lab. Materials are available through a variety of vendors. This order is for Sargent Welch and for the fireworks. Because some of the materials are considered hazardous, they can only be shipped directly to your school.

Sargent Welch: 800-932-5000

| | |
|---|---|
| Metal Spatula | WLS75289 |
| Chemplates | WLS70041 |
| Magnets | WLS44377-30 |
| Magnifiers | WLS44550 |
| Dropper bottles | WLS8830-C |
| 6 M HCl | WLC97040-07 |
| Lead Shots | WLC94824-06 |
| Copper Shots | WLC94125-06 |
| Aluminum Shots | WLC94008-06 |
| Copper II Sulfate Pieces | WLC94769-08 |
| Magnesium Strips | WLC 95012-02 |
| Iron Shavings | WLC94155-06 |
| Oyster Shell Pieces (Calcium Carbonate) | WLC94195-06 |
| | |
| | |

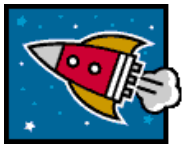
Fireworks – Snakes and Sparklers can be purchased from Walmart (online)



# Analyzing Planetary Surface Samples-Table 1
# Teacher Key

| Substance # | Initial Appearance | Density >1 or <1 | Magnetic Yes or No | HCl Test + or - | Observations During Heating | Observations In Water |
|---|---|---|---|---|---|---|
| 1 | Reddish, metallic ball | >1 | No | - | Turns bluish when heated, returns to normal when cooled | Nothing |
| 2 | Dull, silver metallic ball | >1 | No | - | Melts to silvery liquid | Nothing |
| 3 | Bright metallic silver ball | >1 | No | - | Nothing | Nothing |
| 4 | Small whitish crystal | >1 | No | - | Burns black | Expands to jelly-like substance |
| 5 | Bluish rock | >1 | No | - | Turns white when heated | Turns water bluish after awhile |
| 6 | Blackish rock | >1 | No | - | Expands rapidly to black “snake” | Nothing |
| 7 | Silvery metallic strip | >1 | No | - | Burns with a brilliant white light | Nothing |
| 8 | Brownish rock | >1 | No | - | Nothing | Nothing |

| Substance # | Initial Appearance | Density >1 or <1 | Magnetic Yes or No | HCl Test + or - | Observations During Heating | Observations In Water |
|---|---|---|---|---|---|---|
| 9 | Fine reddish-brown shavings | >1 | Yes | - | Creates sparkles when dropped on burner flame | Nothing |
| 10 | Small silvery pieces | >1 | No | - | Burns with bright sparkles of white light | Nothing |
| 11 | Flattened grayish- brown pieces | >1 | No | + | Nothing | Nothing |
| 12 | White Chips | <1 | No | + | Nothing | Gives off a gas and dissolves |



# Analyzing Planetary Surface Samples- Teacher Key

Name: _____ Date: _____

Answer the following questions:

1. Use the dichotomous key below to identify as many of the samples as possible on Table 1-Student Sheet.

Planetary Sample Dichotomous Key

1.
   A. Is spherical in shape ……..……GOTO 2
   B. Is not spherical in shape ……..……..GOTO 4

2.
   A. Has a silvery or gray metallic luster……...…..GOTO 3
   B. Does not have a silvery or gray metallic luster…….…….……Copper

3.
   A. Melts to a liquid under direct heat…….……Lead
   B. Does not melt to a liquid under direct heat…….....GOTO 11

4.
   A. Is attracted by a magnet……..Iron
   B. Is not attracted by a magnet……GOTO 5

5.
   A. Expands to a jelly-like substance when left in water…….…....Polymer
   B. Does not expand when left in water……GOTO 6

6.
   A. Is metallic in luster and ribbon-like in shape……Magnesium
   B. Is not metallic in luster and ribbon-like in shape……..…..GOTO 7

7.
   A. Is black, yellow, or blue in color……..…..GOTO 8
   B. Is not black, yellow, or blue in color……GOTO 10

8.
   A. Melts and burns with a blue flame when heated, strong odor……..…Sulfur
   B. Does not melt and burn with a blue flame…….…..GOTO 9

9.
   A. Turns white when heated…….Copper Sulfate
   B. Produces a long black snake when heated…….……..Carbon compound

10.

A. Gives off a gas (bubbles) when HCL is added……..GO TO 12
B. Does not give off a gas when HCL is added……..Inorganic rock

11.

A. Shoots off sparks when heated……Unknown
B. Does not shoot off sparks when heated……..Aluminum

12.

A. Dissolves in water……Sodium Compound
B. Does not dissolve in water……Fossil Material

| Sample # | Identification of Sample |
|---|---|
| 1 | copper |
| 2 | lead |
| 3 | aluminum |
| 4 | polymer |
| 5 | copper sulfate (hydrate) |
| 6 | carbon compound |
| 7 | magnesium |
| 8 | inorganic rock |
| 9 | iron |
| 10 | unknown |
| 11 | fossil material |
| 12 | Sodium compound |

2. Did the results from your test support or refute your hypothesis? Explain your answer completely. **Answers will vary depending on their hypothesis and results.**

3. What type of elements, minerals, or rocks do you think might be present in the sample that was collected from your test site? **See above chart.**

4. From the samples that you examined, do you think that life may have existed on the planet? Explain your answer. **Answers will vary, but because fossil-like materials were found as well as carbon compounds and hydrates (copper sulfate), there is a strong possibility that life may have existed on the planet in the past.**

5. From the samples that you examined, do you think that the planet presently, or in the past, may have had water on its surface? Explain your answer**. Yes, copper sulfate is a hydrate that can only be formed in the presence of water.**

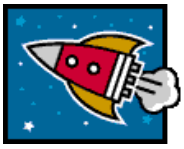
6. From the observations that you made in this activity write three plausible theories about the geological and biological makeup (past or present) of the planet.

**Answers will vary...some plausible conclusions are:**

**1. The planet at one time had organic life of some type.**

**2. The planet at one time had water on its surface.**

**3. The planet has minerals similar to some we find on earth.**



# Analyzing Planetary Surface Samples-Student Directions

1. Put on safety glasses.
2. Obtain your container of "Planetary" surface samples. The samples are labeled according to the location that they were taken from (1, 2, or 3).
3. Note which location your sample was taken from and record it on Analyzing Planetary Surface Samples-Table 1.
4. Open the containers and separate like materials into separate piles on a white sheet of paper, numbering each specific type.
5. Examine each material carefully with the tools provided.
6. Test the samples to see if they are magnetic.
7. Write a description of each type of substance in Analyzing Planetary Surface Samples-Table 1.
8. Fill the small beaker with water.
9. Using the dropper or pipette, add a small amount of water into each of the wells in the first chemplate.
10. Divide each group that you numbered into three smaller piles, with several pieces in each.
11. Using the tweezers or spatula, transfer several pieces from one of the smaller piles from each numbered group to one of the wells in the tray that contain water.
12. Record the density of the samples in Table 1 (if the sample floats, its density is less than 1, if it sinks, its density is greater than 1)
13. Let the sample stand in water for at least 10 minutes before recording any further observations.
14. Allow your instructor to light the alcohol burner.
15. Lay out your aluminum foil or tray and place your burner in the center of it (this is to prevent any damage to the surface of the tables).
16. Using the tweezers or spatula, whatever holds the material best, heat one or two pieces from the second pile from each sample for about 30 seconds.

17. Observe any changes in the material and record them in Table 1.

18. When all of the materials have been tested by the flame, put out your alcohol burner.

19. Return to the samples that were placed in water and make observations on them and record your results in Analyzing Planetary Surface Samples-Table 1.

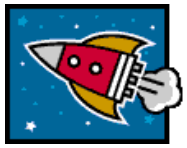
20. Put several pieces from the third smaller pile of each sample into the wells of the second chemplate, one type in each well.

21. Add several drops of 6M HCl to each of the samples.

22. Record any reaction (bubbling) in Table 1.

23. Clean up your lab area according to your teacher's directions.

24. Answer the questions on the Analyzing Planetary Surface Samples-Student Sheet.



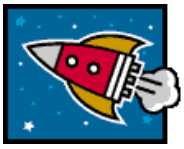
# Analyzing Planetary Surface Samples-Table 1
# Student Sheet

Name: _____ Date: _____

Which site did your samples come from?

| Substance # | Initial Appearance | Density >1 or <1 | Magnetic Yes or No | HCl Test + or - | Observations During Heating | Observations In Water |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |

| Substance # | Initial Appearance | Density >1 or <1 | Magnetic Yes or No | HCl Test + or - | Observations During Heating | Observations In Water |
|---|---|---|---|---|---|---|
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | | | | | | |



# Analyzing Planetary Surface Samples- Student Sheet

Name: _____ Date: _____

Answer the following questions:

2. Use the dichotomous key below to identify as many of the samples as possible on Table 1-Student Sheet.

Planetary Sample Dichotomous Key

1.
   C. Is spherical in shape ……..……GOTO 2
   D. Is not spherical in shape ……..……..GOTO 4

2.
   C. Has a silvery or gray metallic luster……...…..GOTO 3
   D. Does not have a silvery or gray metallic luster…….…….……Copper

3.
   C. Melts to a liquid under direct heat…….……Lead
   D. Does not melt to a liquid under direct heat…….....GOTO 11

4.
   C. Is attracted by a magnet……..Iron
   D. Is not attracted by a magnet……GOTO 5

5.
   C. Expands to a jelly-like substance when left in water…….…....Polymer
   D. Does not expand when left in water……GOTO 6

6.
   C. Is metallic in luster and ribbon-like in shape……Magnesium
   D. Is not metallic in luster and ribbon-like in shape……..…..GOTO 7

7.
   C. Is black, yellow, or blue in color……..…..GOTO 8
   D. Is not black, yellow, or blue in color……GOTO 10

8.
   C. Melts and burns with a blue flame when heated, strong odor……..…Sulfur
   D. Does not melt and burn with a blue flame…….…..GOTO 9

9.
   C. Turns white when heated…….Copper Sulfate
   D. Produces a long black snake when heated…….……..Carbon compound

10.

C. Gives off a gas (bubbles) when HCL is added……..GO TO 12
D. Does not give off a gas when HCL is added……..Inorganic rock

11.

C. Shoots off sparks when heated……Unknown
D. Does not shoot off sparks when heated……..Aluminum

12.

A. Dissolves in water……Sodium Compound
B. Does not dissolve in water……Fossil Material

| Sample # | Identification of Sample |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | |

3. Did the results from your test support or refute your hypothesis? Explain your answer completely.

4. What type of elements, minerals, or rocks do you think might be present in the sample that was collected from your test site?

5. From the samples that you examined, do you think that life may have existed on the planet? Explain your answer.

6. From the samples that you examined, do you think that the planet presently, or in the past, may have had water on its surface? Explain your answer.

7. From the observations that you made in this activity write three plausible theories about the geological and biological makeup (past or present) of the planet.

   1.

   2.

   3.