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**Properties of Clay**

**Writer:** Jennifer Rogers

**Grade Level:** 6

**Big Picture Concepts:** Environment, Investigation, Observation, Variation

**Subject Areas:** Science, Social Studies, Visual Arts

**Essential Question:** How are various materials from the environment used to create art? How does environment affect the texture of soil?

**Abstract:** Students will examine the physical properties of soil by studying works of art, testing local samples, and using soil to create their own works of art.

**Duration:** 200 minutes

**Focus Works of Art:**



Unknown Artist (Costa Rican, Guanacaste or Diquís Region)

***Peccary Effigy Jar*, circa 1000-1550**

Ceramic with red-orange and black on cream slip paint

H. 12 1/8 in. (30.8 cm)

[www.artnc.org/node/346](http://www.artnc.org/node/346)



Unknown Artist (Costa Rican)

***Crocodile Effigy Vessel*, circa 300-1100**

Ceramic

H. 5 3/4 in. (14.6 cm)

[www.artnc.org/node/348](http://www.artnc.org/node/348)



Unknown Artist (Costa Rican)

***Jaguar Effigy Incense Burner*, circa 300-1000**

Ceramic

11 3/8 x 7 1/2 in. (28.9 x 19.1 cm)

[www.artnc.org/node/347](http://www.artnc.org/node/347)



Thomas Hart Benton (American, 1889-1975)

***Spring on the Missouri*, 1945**

Oil and tempera on Masonite panel

30 1/4 x 40 1/4 in. (76.8 x 102.2 cm)

[www.artnc.org/node/317](http://www.artnc.org/node/317)

**North Carolina Standards Correlations:**

Science: 6.E.2.3

Social Studies: 6.G.1.4

Visual Arts: 6.V.1.1, 6.V.3.3, 6.CX.1.1, 6.CX.2.2 -

**Student Learning Objectives:**

* Students will compare and contrast different soil textures.
* Students will examine the physical properties of clay and determine its suitability as an art material.
* Students will use knowledge of Costa Rican geography to determine the availability of clay as a natural resource and art material.
* Students will compare and contrast the composition and characteristics of clay found in the soil with those of manufactured clay.

**Activities:**

**Day 1**

1. Break the class into small discussion groups. Assign each group an image of one of the three ceramic works of art. Ask the students to discuss the work as a group and make a list of the physical characteristics of the work of art (or what they *see*).
2. After students have a list of observable characteristics, ask the students to work as a group to write a paragraph or create a graphic organizer that describes the physical properties of clay based on their ceramic object and list of observations.
3. Have the groups present their analysis to the class.
4. During the presentations, create a class chart that lists clay's physical properties, noting areas of variability such as color and texture.
5. Lead a discussion about natural resources. Ask students to make predictions about what natural resources were available during this time in Costa Rica and how they could be used. Questions include: *What natural resources do you think were available to people living in Costa Rica at this time?* (gold, clay, wood) *How can artists use these materials to create works of art? Where would artists have gotten these materials during this time in Costa Rica?*
6. For homework: Have students research natural resources in Costa Rica to confirm their predictions. Ask students use the Costa Rica Natural Resources Research Handout to guide their research. Students should also bring in a small (quart-size bag) sample of soil from around their home.

**Day 2**

1. Discuss the research students completed about Costa Rica's resources. Share the background information about each piece of ceramic art. Discuss natural resources and how they are used for art materials. Questions include: *What natural resources were available to people living in Costa Rica at this time?* (gold, clay, wood) *How can artists use these materials to create works of art? Where would artists have gotten these materials during this time? Why would these materials be good mediums to use to create art? What drawbacks might these materials have?*
2. Discuss soil texture with the class by showing the Soil PowerPoint.
3. Have students complete the "What's Your Soil Texture?" lab using soil samples that the students supply from around their homes. Review soil texture by doing a Texture-by-Feel analysis and by using the Soil Triangle. To use the Soil Triangle, students will create a "soil shake." Allow these to settle overnight.

**Day 3**

1. Compare the results of the soil texture lab. Students will measure each layer of their "soil shake" and create a ratio of each layer of the soil's texture compared to the entire sample. Students will then convert these into percentages and use the Soil Triangle to determine their soil's texture. Students will complete the "What's Your Soil Texture?" analysis and conclusion questions.
2. After students have determined the texture of each sample, label and group the local soil samples as clay, sand, and silt. Allow students to make observations of each group (sand, silt, clay) and compare and contrast the soil samples by using the Soil Texture Graphic Organizer. Students should observe physical characteristics, texture, color, and consistency. Students should use the sense of touch to observe as well as observe the soil using a hand lens.
3. As a class, discuss the properties of materials that may be appealing to an artist (malleability, color, availability). Ask students to use their comparisons of the sand, silt, and clay to evaluate each type of soil to be used for art making. Have students write a short paragraph describing which soil texture they believe would be the best to use for creating ceramic art. Students should use their analysis of the soil (from their graphic organizer) to defend their reasoning.
4. Have students compare the physical characteristics of the local samples of soil with clay purchased from an art-supply store. As a class, discuss the reasons the store-bought clay has been manufactured to accentuate particular physical properties.

**Day 4**

1. Project and discuss *Spring on the Missouri* by Thomas Hart Benton. Questions may include: *What do you see in this picture? What do you think is going on? What do you see that makes you say that? What natural force is shown in this picture? How do natural forces affect the environment, humans, and other creatures? How are the people reacting to this natural phenomenon? How does the artist use texture in this painting?*
2. Discuss background, middle ground, and foreground of paintings. Have students pick out the background, middle ground, and foreground on *Spring on the Missouri.* Ask students: *How does the artist distinguish between each one? What effect does this have on the painting?*
3. Using a large (11x14) piece of poster board, have students sketch a dramatic nature scene. Tell students to be sure that their drawing shows the difference between the background, middle ground, and foreground.
4. Tell students that they are going to be using materials from the earth to create a painting. Students should use the local soil samples to create a paint by mixing the soil with glue and water. (Students can create the consistency they want by using more or less water/glue mixture).
5. Students should use the paint to paint their dramatic nature scenes, taking careful consideration into painting the background, middle ground, and foreground.
6. Once students' paintings are dry, ask students to complete the reflection handout and share reflections with the class.

**Assessment:**

* Group list, paragraph/graphic organizer, and class discussion may be used to assess students' understanding of clay's physical properties.
* Students' homework assignment and discussion about Costa Rica's natural resources demonstrate the students' understanding of the relationship between art materials and natural resources.
* "What's Your Soil Texture?" lab is used to assess students' knowledge of soil textures. (Soil Texture Rubric)
* The Soil Graphic Organizer assesses students on comparing and contrasting the texture of soil. (Soil Texture Rubric)
* The analysis of soil composition and manufactured clay may be used to assess whether students are able to apply knowledge of clay's properties. (Soil Texture Rubric)
* Students’ painting and reflection will show use of background, middle ground, and foreground and the process of creating the painting. Students’ understanding of texture in art and soil will also be assessed through the reflection. (Soil Texture Rubric)

**Resources:**

Vocabulary:

natural resource

effigy

peccary

shamans

incense

texture

malleability

sand

silt

clay

soil triangle

texture-by-feel analysis

background

middle ground

foreground

Materials:

1. Soil from students' homes or various locations around town

2. Clear bottles with lids (water bottles, small soda bottles, etc.)

3. Rulers

4. Calculators

5. Copies of Texture-by-Feel Guide (attached to lab)

6. Copies of Soil Triangle (attached to lab—if laminated, they can be reused
 with a Vis-a-Vis marker

7. Hand lens

8. Samples of manufactured clay

9. Large pieces of poster board

10. Paint brushes

11. Glue

12. Water

13. Containers to mix paint (muffin tins, butter containers, etc.)

14. Image of *Crocodile Effigy Vessel*
15. Image of *Peccary Effigy Jar*
16. Image of *Jaguar Effigy Incense Burner*

Links:

Images of Costa Rica
<http://www.photographyincostarica.com/>

<http://www.govisitcostarica.com/travelInfo/photo.asp>

Costa Rica Natural Resources Research Handout

Soil Texture PowerPoint

<http://new.artnc.org/sites/default/files/documents/Soil%20Texture.ppt>

"What's Your Soil Texture?" lab report

Soil texture graphic organizer

Soil texture rubric

Soil Painting reflection handout

**Costa Rica Natural Resources**

Prediction : Use your prior knowledge to make a prediction about natural resources.

1. Think about the pieces of ceramic art that you observed. Based on this, what natural resources do you think are found in Costa Rica?

2. Where do natural resources come from?

3. How do you think natural resources could be used as art materials? What would artists do with these materials?

Research: Use the following Web sites to analyze Costa Rica's natural resources.

4. Go to the Web site http://pages.interlog.com/~rainfrst/geog.html to learn about the different regions of Costa Rica. Answer the following questions:

 a. What countries and bodies of water border Costa Rica?

 b. How many climate zones are found in Costa Rica?

c. What do you think the soil would be like in the mountains?

5. Go to http://centralamerica.com/cr/info/ and read "A Brief History of Costa Rica". Answer this question: What kind of resources were used in the early days of Costa Rica? (Hint: What kinds of artifacts have been found? What other resources were used?)

6. Visit http://www.travelcostaricaonline.com/costa-rica-geography.html to learn about current natural resources. Answer this question: What types of natural resources are found in Costa Rica today?

7. Explore the maps at http://www.costa-rica-life.com/map-of-costa-rica.html to see the difference in regions. Click on the first map to explore in Google Earth.

Analysis: Compare your predictions to your research.

8. What did you learn about the natural resources in Costa Rica?

9. How did your prediction compare to your research?

**Soil Painting Reflection**

In a paragraph, describe your painting. What dramatic nature scene does your painting show? How did the soil work as a paint? Compare the different soils that you used to paint with. Which ones gave the painting more of a 3-D effect? Which soil made a smoother paint? Which kind of soil would you prefer to use as a paint? How does the texture of your overall painting compare to the actual texture of the soil (sand, silt, clay)?

**Soil Texture**

Make observations about each type of soil. How are they similar? Different? Use your eyes and sense of touch to make observations about physical properties, texture, color, consistency, and organic matter.

Using Materials from the Earth to Create Art

Use your comparisons of the sand, silt, and clay to evaluate each type of soil to be used for art making. Write a short paragraph describing which soil texture you believe would be the best to use for creating ceramic art. Use your observations to analyze the soil and defend your choice.

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Soil Texture Rubric**

|  |  |  |  |
| --- | --- | --- | --- |
| CATEGORY | 20 points | 10 points | 0 point |
| "What's Your Soil Texture?" Lab | Student completed all parts of the lab. Students correctly used the soil triangle for practice problems and in the local soil analysis. Measurements and calculations are accurate, correct, and labeled with the correct unit. Conclusions questions are answered thoroughly.  | Student completed most parts of the lab. Students missed fewer than 3 practice problems for the soil triangle. Measurements and calculations are not accurate or labeled with the correct unit. Conclusions questions are generally answered. | Student completed some parts of the lab. Missed more than 3 practice problems for the soil triangle. Measurements and calculations are inaccurate. Conclusions questions are not answered.  |
| Soil Texture Graphic Organizer  | Student completed all parts of the graphic organizer, adding specific details and observations about all 5 categories (physical properties, texture, color, consistency, and organic matter). | Student completed some parts of the graphic organizer, adding general details and observations about 4 of the 5 categories (physical properties, texture, color, consistency, and organic matter). | Student completed some parts of the graphic organizer, adding vague details and observations about fewer than 4 of the 5 categories (physical properties, texture, color, consistency, and organic matter). |
| Soil Analysis Paragraph | Student used observations and details from graphic organizer to defend his/her reasoning behind choosing the best soil texture. Student uses specific science and art vocabulary.  | Student used some observations and details from graphic organizer to defend his/her reasoning behind choosing the best soil texture. Student uses general science and art vocabulary. | Student fails to use observations and details from graphic organizer. Student does not defend his/her choice about the best soil. Student does not use science or art vocabulary.  |
| Soil Painting Reflection | Student answered all questions in reflection with detailed, thoughtful answers by using both science and art vocabulary. | Student answered most questions in reflection with little details while using some science and/or art vocabulary. | Student did not answer questions in reflection. No art or science vocabulary was used.  |
| Participation  | Used time well in lab and focused attention on the experiment. | Used time pretty well. Stayed focused on the experiment most of the time. | Did the lab but did not appear very interested. Focus was lost on several occasions. |

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**What’s Your Soil Texture?**

Purpose: To determine the texture of your soil.

Materials: Soil sample, plastic container with lid, water, Texture-by-Feel Guide, Soil Triangle, vis-à-vis marker, ruler, calculator

Procedure:

1. What are the three soil particles that determine soil texture?
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Use the “Texture by Feel Guide” to try to determine your soil type. Follow the steps of the flow chart. Make a hypothesis about what type of soil you have. Record your type of soil below.
6. Follow the steps below to mathematically determine what kind of soil you have.
	1. Fill your container no more than half full of your soil sample.
	2. Wet the soil to a mud consistency and tap the jar to settle the soil.
	3. With your ruler, measure the height of the soil sample in centimeters and record it below.
	4. Height of sample =
	5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm

Soil Sample

1. Raise your hand when you are ready to add more water. Pour in enough water to double the total volume of your sample.

Soil Sample

Water

Soil Sample

1. Now that you have your mixture of soil and water, seal the lid tightly.
2. Now shake the jar until all of the soil and water are mixed up.
3. Put the container on the shelf and let the soil settle. Do not touch the container or shake it while the soil is settling.

Using the Soil Triangle, determine the texture of the following soils with the given percentages:

1. 20% sand, 10% clay, & 70 % silt:

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. 60% sand, 10% clay & 30% silt:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. 40% sand, 50% clay & 10% silt:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. 10% sand, 0% clay, & 90% silt:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Answer the following questions about soil texture by using your Soil Triangle:

1. Can clay have sand in it?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Which has more sand, silt or loam?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Which has more clay, silt loam or sandy clay?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Can silt have clay in it?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Check your soil sample to see if your soil has settled yet. Measure the height of each of the layers of your soil. Record your observations below.

 Clay = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm

 Silt = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm

 Sand = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm

1. Add the amounts of sand, silt and clay together.

Clay = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_cm

 Silt = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_cm

 + Sand = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_cm

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Total = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm

Is this total amount different from the amount of soil you measured in Step 3 (yes or no)? If yes, explain why this might happen.

Now you will calculate the percentage of sand, silt, and clay in your soil sample. Remember that percentages describe a portion of the total amount.

Example: % of clay = depth of clay in cm X 100

 depth of total sample in cm

Show your work below:

 % of clay = cm X 100

 cm

% of clay =

 % of silt = cm X 100

 cm

% of silt =

% of sand = cm X 100

 cm

% of sand =

Now use the Soil Triangle. Use the percentages to figure out what kind of soil you have.

Conclusion:

My type of soil is

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Was your hypothesis accurate, close, or far off from what you mathematically determined your sample to be?

Why do you think some people’s Texture by Feel predictions might not have been accurate?