

# Density of Minerals

## Task Information

**Subject:** Earth Science

**Content:**

- NYS Syllabus Topic I B.- 2. Density
- MST framework - Standard 4 - Matter has observable properties and is made up of particles that may interact.
- Middle Level Syllabus Block D I C - 1 Mineral Identification

**Format:** Manipulative

**Purpose:**

- Measuring mass and volume and calculating density of mineral samples.

**Skills:**

**Primary:** Measuring, recording data, applying math  
**Secondary:** Inferring

**Time:** 20 minutes

**Materials:**

**Teacher:**

- extra paper towels

**Per Student:**

- metric balance
- graduated cylinder (ml)
- overflow cup
- beaker & water
- mineral samples A & B
- calculator
- paper towels

**Preparation:**

- A. Selection of mineral samples;  
 The samples must;
  - fit the size of the overflow cups
  - not be soluble
  - be those that students are familiar with.
- B. Marking samples:
  - Use white paint and a fine tip permanent marker.
  - Mark the samples A1, B1; A2, B2; etc.
- C. Measure mass and volume of samples and record data for use in scoring student work.

**Safety:**

- If graduated cylinders are glass, place a small amount of modeling clay at the bottom of the cylinder to prevent breakage should a mineral sample be dropped.

**Extensions/Modifications:**

If small specimens of minerals are available and overflow cups are not, minerals may be lowered with a string into the graduated cylinders to get a volume reading.

## Density of Minerals

**Task:** At this station, you will determine the mass, volume and density of two (2) mineral samples. Data and calculations will be recorded precisely and accurately within the limits of the measurement tools.

**Materials:**

- metric balance
- graduated cylinder
- overflow cup
- beaker with water
- mineral samples A and B
- calculator

**Background:**

Minerals are the different materials which make up the various rocks of the earth. Each mineral has its own set of identifying properties. Density is one of the properties often used to identify minerals. Rocks are one or more minerals which have been put together in different ways. The properties of the rocks, made of the same minerals, may be different depending on how the rocks were made. Mineral densities are nearly always the same.

**Directions:**

1. Record the code number of each mineral sample and find the mass of each to the nearest tenth of a gram.

A Code Number \_\_\_\_\_ Mass \_\_\_\_\_

B Code Number \_\_\_\_\_ Mass \_\_\_\_\_

2. Record the code number and find the volume of each mineral sample to the nearest whole  $\text{cm}^3$ (ml).

A. Code Number \_\_\_\_\_ Volume \_\_\_\_\_

B. Code Number \_\_\_\_\_ Volume \_\_\_\_\_

3. In the space below, describe the procedure you used to find the volume of the minerals.

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**Please Continue on the Next Page**

4. What is the density of the mineral samples? Record your answers to the nearest tenth place.

A Code Number \_\_\_\_\_ Density \_\_\_\_\_

B Code Number \_\_\_\_\_ Density \_\_\_\_\_

Show your work in the space below.

density =  $\frac{\text{mass}}{\text{volume}}$

Mineral sample A Calculations

Mineral sample B Calculations

5. The metamorphic rock Quartzite and a sedimentary rock sandstone are both made of the mineral quartz that has a density of 2.65 grams/cubic cm ( $\text{g/cm}^3$ ). A geologist determined the density of a sample of quartzite to have a density of  $2.65 \text{ g/cm}^3$  and determined the sample of sandstone to have a density of  $2.45 \text{ g/cm}^3$ .

A. In complete sentences, explain why the sample of quartzite has a different density from the sample of sandstone.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

B. In complete sentences, explain why densities of the quartz and the sample of quartzite are the same.

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\_\_\_\_\_



**Density of Minerals - Scoring Rubric****Maximum score - 25 points****Task 1. Mass****6 points total**Standard: The student will determine and record precise measurements of mass.Criteria:

- A. Mass of mineral A
  - Allow 2 points if the mass is  $\pm 0.2$  g.
  - Allow 1 point if the mass is  $\pm 0.5$  g.
  - No credit is given if the mass is  $\pm > 0.5$  g.
- B. Mass of mineral B
  - Allow 2 points if the mass is  $\pm 0.2$  g.
  - Allow 1 point if the mass is  $\pm 0.5$  g.
  - No credit is given if the mass is  $\pm > 0.5$  g.
- C. Labeling
  - Allow 1 point for labeling both measurements with units.
- D. Recording
  - Allow 1 point for all data accurately recorded to the nearest tenth of a gram.

**Task 2. Volume****6 points total**Standard: The student will determine and record precise measurements of volume using the displacement method.Criteria:

- A. Volume of mineral sample A
  - Allow 2 points if the mass is  $\pm 1$  cm<sup>3</sup>
  - Allow 1 point if the mass is  $\pm 2$  cm<sup>3</sup>
  - No credit is given if the mass is  $\pm > 2$  cm<sup>3</sup>
- B. Volume of mineral B
  - Allow 2 points if the mass is  $\pm 1$  cm<sup>3</sup>
  - Allow 1 point if the mass is  $\pm 2$  cm<sup>3</sup>
  - No credit is given if the mass is  $\pm > 2$  cm<sup>3</sup>
- C. Labeling
  - Allow 1 point for labeling both measurements with units.
- D. Recording
  - Allow 1 point for all data accurately recorded to the nearest whole milliliter.

**Comment #1** - The units cm<sup>3</sup> and ml are both acceptable based on the student's instruction.**Tasks 3. Volume Procedure****2 points total**Standard: The student will describe the displacement procedure for determining volume.Criteria:

- Allow 2 points for a clear, accurate description of the displacement method.
- Allow 1 point for a partially accurate or partially unclear description.
- No credit is given if the answer is unclear, inaccurate, or not provided..
- Complete sentences are not required to receive credit.



**Tasks 4. Density Calculations****8 points total**

Standard: The student will calculate the density of mineral samples and show work.

Criteria:

Mineral sample A:

- A. Substitution
  - Allow 1 point for correct substitutions into the equation. (Units not required.)
- B. Calculation (See comment 2.)
  - Allow 2 points if the density is  $\pm 0.2 \text{ g/cm}^3$  or  $\text{g/mL}$ .
  - Allow 1 point if the density is  $\pm 0.5 \text{ g/cm}^3$  or  $\text{g/mL}$ .
  - No credit is given if the density is  $\pm > 0.5 \text{ g/cm}^3$  or  $\text{g/mL}$ .

Mineral sample B:

- A. Substitution
  - Allow 1 point for correct substitutions into the equation. (Units not required.)
- B. Calculation (See comment 2.)
  - Allow 2 points if the density is  $\pm 0.2 \text{ g/cm}^3$  or  $\text{g/mL}$ .
  - Allow 1 point if the density is  $\pm 0.5 \text{ g/cm}^3$  or  $\text{g/mL}$ .
  - No credit is given if the density is  $\pm > 0.5 \text{ g/cm}^3$  or  $\text{g/mL}$ .

Labeling and Recording:

- A. Labeling
  - Allow 1 point if both answers are labeled correctly.
- B. Recording
  - Allow 1 point if both answers are recorded to the nearest tenth of a  $\text{g/cm}^3$  or  $\text{g/mL}$ .

**Comment #2.** - Double jeopardy: The student should not be penalized twice for the same error. Answers should be consistent with, and based on, data recorded in earlier parts of the question.

**Task 5. Rock Differences****3 points total**

Standard: The students will give a logical, scientifically accurate explanation for differences or similarities in rock densities.

Criteria:

- A. Sedimentary rocks are composed of cemented grains and include pore space or other minerals between the grains. The density of the sandstone is likely to be lower than the quartzite because of the inclusion of pore space or less dense minerals in the sandstone. The metamorphic process which produces the Quartzite causes a high amount of compaction.
  - Allow 2 points for a logical statement in complete sentences
  - Allow 1 point for a logical answer that is not given in complete sentences
  - No credit for inaccurate answers
- B. Both samples are made of the mineral quartz and the density of quartz is 2.65. Quartzite contains very little or no pore space.
  - Allow 1 point for a correct response
  - Allow no point for an incorrect response

**Highest possible score - 25 points**

Student ID \_\_\_\_\_

Density of minerals - Scoring Form

Male or Female (circle one)

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

<b>1. Mass</b>	<u>+/- &gt;0.5g</u>	<u>+/- 0.5g</u>	<u>+/- 0.2g</u>
A. Mineral sample A	0	1	2
B. Mineral sample B	0	1	2
C. Labeling unit	0	1	
D. Recording measurements to the nearest tenth	0	1	
<b>2. Volume</b>	<u>+/- &gt;2cm<sup>3</sup></u>	<u>+/- 2cm<sup>3</sup></u>	<u>+/- 1cm<sup>3</sup></u>
A. Mineral sample A	0	1	2
B. Mineral sample B	0	1	2
C. Labeling units	0	1	
D. Recording measurements to the nearest tenth	0	1	
<b>3. Procedure</b>	0	1	2
<b>4. Density</b>			
Mineral sample A			
A. Substitution of correct data in the equation	0	1	
B. Correct calculation of density	0	1	2
Mineral sample B			
A. Substitution of correct data in the equation	0	1	
B. Correct calculation of density	0	1	2
Labeling and Recording			
A. Labeling units correctly	0	1	
B. Recording measurements to the nearest tenth	0	1	
<b>5. Rock Differences</b>			
A. Sandstone & Quartzite	0	1	2
B. Density of Quartz & Quartzite	0	1	

**TOTAL SCORE** \_\_\_\_\_

Total possible score - 25 points

Student ID ES-DM-1

Scoring Form - Density of minerals

Male or Female (circle one)

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

	<u>+/- &gt;0.5g</u>	<u>+/- 0.5g</u>	<u>+/- 0.2g</u>
<b>1. Mass</b>			
A. Mineral sample A	0	1	(2)
B. Mineral sample B	0	1	(2)
C. Labeling unit	0	(1)	
D. Recording measurements to the nearest tenth	0	(1)	
<b>2. Volume</b>			
A. Mineral sample A	<u>+/- &gt;2cm<sup>3</sup></u>	<u>+/- 2cm<sup>3</sup></u>	<u>+/- 1cm<sup>3</sup></u>
B. Mineral sample B	0	1	(2)
C. Labeling units	0	(1)	
D. Recording measurements to the nearest tenth	0	(1)	
<b>3. Procedure</b>	0	1	(2)
<b>4. Density</b>			
Mineral sample A			
A. Substitution of correct data in the equation	0	(1)	
B. Correct calculation of density	0	1	(2)
Mineral sample B			
A. Substitution of correct data in the equation	0	(1)	
B. Correct calculation of density	0	1	(2)
A. Labeling units correctly	0	(1)	
B. Recording measurements to the nearest tenth	0	(1)	
<b>5. Rock Differences</b>			
A. Sedimentary Rocks	0	1	(2)
B. Density of Quartz	0	(1)	

**TOTAL SCORE** 25  
(Total possible score - 25 points)

# Density of Minerals

Task: At this station, you will be determining the mass, volume and density of minerals. Data and calculations will be recorded precisely and accurately within the limits of the measurement tools.

## MATERIALS

spring scale or balance  
graduated cylinder  
beaker with water  
minerals A and B  
calculator

$$\frac{25}{25}$$

14 min

## DIRECTIONS

1. Record the code number of each mineral and find the mass of each mineral:

A. Code Number 2-8B Mass 12.9 g.

B. Code Number 2-8F Mass 35.0 g

2. Record the code number and volume of each mineral:

A. Code Number 2-8B Volume 5 ml.

B. Code Number 2-8A Volume 4 ml.

3. In the space below, describe the procedure you used to find the volume of the minerals.

To find the volume of mineral A  
I used the graduated cylinder  
and I filled it with water. Then I  
put the mineral in and marked  
how much the water rose  
up. I did the same for the mineral B

PLEASE CONTINUE THIS TEST  
ON THE NEXT PAGE



Student ID ES-DM-2  
 Male or Female (circle one)

Scoring Form - Density of minerals

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

	<u>+/- &gt;0.5g</u>	<u>+/- 0.5g</u>	<u>+/- 0.2g</u>
<b>1. Mass</b>			
A. Mineral sample A	0	1	2
B. Mineral sample B	0	1	2
C. Labeling unit	0	1	
D. Recording measurements to the nearest tenth	0	1	
<b>2. Volume</b>			
	<u>+/- &gt;2cm<sup>3</sup></u>	<u>+/- 2cm<sup>3</sup></u>	<u>+/- 1cm<sup>3</sup></u>
A. Mineral sample A	0	1	2
B. Mineral sample B	0	1	2
C. Labeling units	0	1	
D. Recording measurements to the nearest tenth	0	1	
<b>3. Procedure</b>	0	1	2
<b>4. Density</b>			
Mineral sample A			
A. Substitution of correct data in the equation	0	1	
B. Correct calculation of density	0	1	2
Mineral sample B			
A. Substitution of correct data in the equation	0	1	
B. Correct calculation of density	0	1	2
A. Labeling units correctly	0	1	
B. Recording measurements to the nearest tenth	0	<del>1</del>	
<b>5. Rock Differences</b>			
A. Sedimentary Rocks	0	1	2
B. Density of Quartz	0	1	

**TOTAL SCORE** 20  
 (Total possible score - 25 points)

# Density of Minerals

**Task:** At this station, you will be determining the mass, volume and density of minerals. Data and calculations will be recorded precisely and accurately within the limits of the measurement tools.

## MATERIALS

spring scale or balance  
graduated cylinder  
beaker with water  
minerals A and B  
calculator

2/25

## DIRECTIONS

1. Record the code number of each mineral and find the mass of each mineral:

A. Code Number 2-5B Mass ~~20.6~~  
B. Code Number 2-5A Mass 30.5

2. Record the code number and volume of each mineral:

A. Code Number 2-5B Volume ~~60.5 ml~~  
B. Code Number 2-5A Volume ~~45 ml~~

3. In the space below, describe the procedure you used to find the volume of the minerals.

Balance or weigh both rocks.  
Put rocks in water + find space taken  
up by rock in water. Then use calculator  
to find the volume by subtraction.

PLEASE CONTINUE THIS TEST ON THE NEXT PAGE