Vermont-PASS Sample Test

Grade 9 Performance Task and Alignment With PASS Performance Task Development Template

"Scuba Divers"

1. Scenario:

Two identical twins named Jill and Rachel were planning separate trips to go scuba diving. Jill planned to scuba dive in the ocean off the coast of Maine and Rachel planned to scuba dive in Lake Champlain.
Scuba divers who dive in cold water locations such as the ones the girls had chosen, must wear wet suits. Wet suits make you more buoyant (cause you to float). In order to sink, divers add lead bars to their belts. Jill and Rachel are the same size and the same weight, however, they were told that they would need to add different amounts of lead to their belts because one planned to dive in the ocean and the other planned to dive in a lake. The girls were curious about this and wondered if the different "sink weights" had something to do with their density compared to the density of the ocean and the lake. They decided to investigate density in order to help them understand this confusing situation. Their investigation question was
"How does the density of an object compare to the density of the liquid in which it is submerged?"

(NSES: National Science Education Standards)

VT Framework: Inquiry – 7.1 bb., cc., dd.
Space, Time, Matter – 7.12 aa.
Notation and Representation- 1.17aa.

Grade Cluster Expectations S : 9 (Physical Science--Properties of Matter)

NSES: Inquiry – 1.3, 1.4, 1.5, 1.7, 1.8, 2.5

2. Problem Statement:

"How does the density of an object compare to the density of the liquid in which it is submerged?"

3. Prediction-Hypothesis:

1) Using the experience of Jill and Rachel and your understanding of density, predict (formulate a hypothesis) how the density of an object must compare to the density of a liquid in order for the object to sink in the liquid. Explain your thinking.

Scoring Guide:
Key Elements: 1. Hypothesis includes cause (density of an object, liquid or both) and effect (object sinks or does not sink in the liquid)
2. Hypothesis states a rational based on the scenario or prior knowledge.

Score Points: 2 points = 2 key elements
1 point = 1 key element

Students can receive points for both key elemets even if their reasoning is flawed. If students collect accurate data, it will be important for them to address the flaws when they answer question #4.

4. Experiment:

Materials

- 200 ml clear beaker or similar size clear container
- 50 ml corn syrup, 50 ml mineral oil, 50 ml colored water
- metric balance
- density cylinder set (metal, PVC, acrylic)
  Optional: small metal object, rubber stopper, PVC plastic
- metric ruler
- tray and paper towels

Management

Field trial analysis of this task recommends separating the materials for Parts 1 and 2 to avoid student confusion. Also, stations containing the three liquids can be set up (preferably near sinks) so that when a student needs the corn syrup sample, he or she can go to an empty corn syrup station. This saves time in set up and avoids the mess of having each student pour and measure at their own desk.

Part 1:

- Calculate the volume of each cylinder by displacement or by measuring the area of the base and the height of the cylinder and using the formula Volume = Area of the Base ($a=\pi r^2$) x Height. Measure in cm^3.
- Use the metric balance to find the mass of each solid cylinder in grams.
- Calculate the density of each solid cylinder using the formula density = mass ÷ volume. Your calculation should be rounded to tenths place.

Note: The cylinders described in this task have a volume of 1 cm^3 and can be obtained from the STC kit *Floating and Sinking* (Carolina Biological Supply) . Common objects can also be substituted. Metal objects sink in the syrup. Rubber stoppers will sink in the oil and water, but float on the syrup. Polyvinylchloride plastic (credit cards, shower curtains, etc.) sink in the oil but float on water. The problem with non-rectangular objects is that the students will need to use displacement to find volume and need to be accurate to tenths place.

5. Data collection and organization:

2) Organize the data you just collected into a table. The title of the table will be "Mass, Volume, and Density". Create, organize and clearly label the table. Your table should include all objects tested and data collected.

Rubric:

Key Elements: 1. table is clearly organized in row and column format, columns or rows are labeled and the table contains the objects measured and mass, volume, and density, and units of measurement are included.
2. table includes data for each variable measured (volume, mass, density for all three objects) and the density calculations are correct order (metal – high, PVC – low).

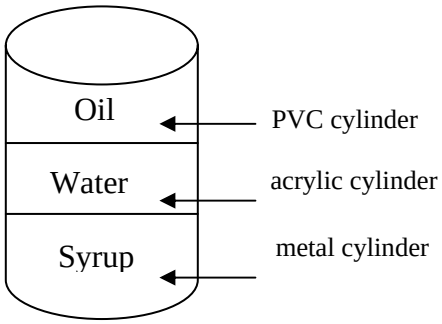
Score Points: 2 points = 2 key elements
1 points = 1 key element

Part 2:

- Carefully pour 50 ml of each of the three liquids into the beaker in the following order:
  Liquid 1: corn syrup
  Liquid 2: colored water
  Liquid 3: mineral oil
- Carefully drop metal cylinder into the beaker.
- Carefully drop acrylic cylinder into the beaker.
- Carefully drop PVC cylinder into the beaker.

3) Make a diagram with labels that represents the positions of the liquids and solids in the beaker.

Rubric:
Key Elements: 1. Diagram is clear and labeled
2. diagram contains the correct position of materials



Score Points: 2 points = 2 key elements
1 point = 1 key elemnet

7. Use of evidence:

4) Do the results of your experiment and the data that the girls found on the internet support your prediction about how the density of an object compares to the density of a liquid in which they are submerged? Explain your thinking. (Provide specific examples from the data on how the experimental results support or refute your predictions.)

Rubric:
Key Elements: 1. Response clearly cites evidence from the experiment as supporting or refuting the hypothesis.
2. Response accurately compares the density of the objects to the density of the liquids.

Score Points: 2 points = 2 key elements
1 score point = 1 key element

5) If the acrylic cylinder was twice as big, what would its position in the beaker be? Explain.

Rubric:
Key Elements: 1. position would stay the same
2. size of an object does not change the density
or
as size increases, mass also increases so density stays the same
or
density is a rate ratio that stays constant for the materials in the experiment

Score points: 2 points = 2 key elements
1 point = 1 key element

6) If salt water has a density of 1.2 g/cm^3 and fresh water has a density of 1 g/cm^3, then which of the twins will need to add more "lead" to her weight belt in order to sink
Rachel in Lake Champlain or **Jill in the Ocean?**

Explain your thinking.

Rubric:
Key Elements: 1. Jill because salt water is more dense than fresh water
Or
Jill because she needs a density greater than 1.2 g/cm^3 but Rachel only needs a density greater than 1 g/cm^3,
Or
Jill because the salt water is more dense and will hold her up more than fresh water.

Score Points: 1point = I key element

7) When water changes state from a liquid to a solid it becomes ice and floats on the liquid water. Use the understanding that you gained from doing this experiment to explain what happens to the density of water when it changes from a liquid to a solid?

Rubric:
Key Elements: 1. Ice is less dense than liquid water
Or
The ice becomes less dense
Or
The ice is not dense enough to sink in the liquid water
Or
The liquid water holds up the ice like it did the PVC cube

Score Points: 1 point = 1 key element