Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Period\_\_\_

**DATA SHEET: Boiling & Freezing a Balloon**

**Objectives:**

1. To understand the relationship between temperature & volume
2. To understand why density increases when objects are cooled & decreases when objects are heated.

**Pre-Lab Questions**

1. What is the equation for density?
2. You will be inflating a balloon and securely tying it shut.
   1. Will the NUMBER of air molecules inside the balloon change or stay the same as you heat and cool the balloon? Explain.
   2. Will the MASS of the air inside the balloon change or stay the same as you heat and cool the balloon? Explain.
3. When air or water is heated, what happens to the molecules? How would heating affect the volume of your balloon?
4. When air or water is cooled, what happens to the molecules? How would heating affect the volume of your balloon?
5. What method of heat transfer relies on differences in temperature that leads to differences in density?
6. **Hypothesis:** Make a hypothesis about the volume of the balloon when it is heated. (If, then, because)

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| --- | --- | --- | --- | --- |
| **Data Table** | **Temp oC** | **Mass**  Assume mass is 150mg for each trial | **Volume**  (Use the circumference measured in  Cm to 1 decimal in place of volume) | **Density Equation –** Show work, circle answer, label with units  \*\*Record answer to 2 decimals  \*\* Label with units |
| **EXAMPLE** | XXX | 150mg | 20.7cm | 150 mg ÷ 20.7cm3 = 7.25 mg/ cm3 |
| **Room Temp** |  |  |  |  |
| **Steam** |  |  |  |  |
| **Ice Water** |  |  |  |  |

**Post-Lab Analysis:**

1. What is the relationship between temperature and volume based on your data? Explain using QUANTITATIVE data from your data table.
2. What is the relationship between temperature and density based on your data? Explain using QUANTITATIVE data from your data table.

**PROCEDURE: Boiling & Freezing a Balloon**

**Materials:**

|  |  |
| --- | --- |
| * Burner w/pan of boiling water * Pan/beaker of ice water, SALTED to bring the temperature below 0oC * Balloon * Piece of “measuring string” (Use string. Yarn varies due to stretch.) | * Thermometer * Timer * Ruler * Calculator * Tongs (to hold balloon over steam) |

**Procedure, Room Temp:**

1. Blow the balloon up fully and then let ½ the air out, so it is ONLY ½ full and tie it.
   1. NOTE: You should still be able to “twist” it. Otherwise it may pop as it expands.
2. **Record the room temperature** in your data table.
3. With string/ribbon and metric ruler, measure the circumference of the balloon from the tied end, around the other end, and back to the tied end. This will make measurements consistent around the fattest part of the balloon.
   1. Record the circumference in **centimeters to the nearest decimal** in your data table.

**Procedure, Boiling:**

1. Using the tongs, hold the balloon in the steam above the boiling water pan for 3 minutes (use timer).
   1. Hold it close, but do not let the balloon actually touch the boiling water.
   2. WHILE holding the balloon, another group member should hold the thermometer so the bulb is in the steam. **Record the temperature of the steam** in your data table.
2. Once the 3 minutes are up, continue to hold the balloon in the steam while another group member carefully measures the circumference in **centimeters to the nearest decimal** in your data table.

**Procedure, Ice Bath:**

1. Allow the hot balloon and thermometer to cool in the room air for 1 minute (to prevent an abrupt temperature change which may cause breaking of the thermometer or balloon).
2. Place the balloon and thermometer into the ice water bath for 3 minutes (use timer).
3. At the end of the 3 minutes **record the temperature of the ice water** in your data table.
4. As soon as you remove the balloon from the water bath, QUICKLY measure the circumference of the balloon in **centimeters to the nearest decimal** in your data table.

