Lab Framework

Text: CORD

Unit number and title: Unit 3 Measuring in English and Metric Units

Short Description: Make and convert temperature measurements using in multiple mediums with the use of different instruments.

Developed by: Thomas Walker

Contact Information: tom.walker@rentonschools.us

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Lab Title

Measurements of Temperature in Air, Liquids, and Humans

LAB PLAN

TEACHER: Teacher Prep/ Lesson Plan

- **Lab Objective**
  1. Read measurements taken with various temperature measurement tools in different applications.
  2. Use common English measurement units for temperature
  3. Use common metric measurement units for temperature
  4. Convert common measurement units for temperature to and from the English and metric systems.
- **Statement of pre-requisite skills needed** (i.e., vocabulary, measurement techniques, formulas, etc.)

  Knowledge of fractions, decimals, percents, and how to convert from one to the other.

  Accurate, precise, degree, Celsius, Fahrenheit, calibration, bulb thermometer, spring thermometer, digital, bulb, oral

  The following should be defined, but not tested: temporal, auxiliary, tympanic
- **Materials List**

  Students
  Document camera & projector
  Cups
  Water
  Isopropyl alcohol (cold / from freezer)
  Environmental thermometer (digital, spring, & bulb)
  Galileo thermometer (if available)
  Cooking thermometer (dial & spring)
  Oral thermometer (digital & bulb) (multiple if others unavailable)
  Rectal bulb thermometer (for visual comparison only - optional)
  Temporal or contact thermometer (if available)
  Tympanic thermometer (if available)
  Clocks / stop watches
  Freezer or cooler with ice

- **State Standards addressed**

  Math:

A1.1.A Select and justify functions and equations to model and solve problems.
A1.8.B Select and apply strategies to solve problems.
A1.8.D Generalize a solution strategy for a single problem to a class of related problems, and apply a strategy for a class of related problems to solve specific problems.
G.6.E Use different degrees of precision in measurement, explain the reason for using a certain degree of precision, and apply estimation strategies to obtain reasonable measurements with appropriate precision for a given purpose.
G.6.F Solve problems involving measurement conversions within and between systems, including those involving derived units, and analyze solutions in terms of reasonableness of solutions and appropriate units.

Reading: (Reading)
Writing: (Writing)

- **Leadership Skills**
  Team collaboration, assigned roles, leader vs. follower, time keeping, group management
- **SCAN Skills/Workplace Skills**

- **Set-up information**
  1. Document camera & projector functioning
  2. Cold & hot water available in room
  3. Isopropyl alcohol kept on ice or in freezer in room
  4. Station "Legend" cards
  5. Worksheet copies available
- **Lab organization**(-Grouping/leadership opportunities/cooperative learning expectations; -**Timeline required)**
  1. Assign to teams of 2-3 members
  2. Assign roles: leader / time keeper, measurer / observer, statistician
  3. Roles may be switched between stations, except that the human measures need to be performed on the same subject.
  4. Students are required to work in teams
- **Teacher Assessment of student learning** (scoring guide, rubric)
  1. Visual observation
  2. Collection of worksheet
- **Summary of learning** (to be finished after student completes lab)
  1. discuss real world application of learning from lab
  2. opportunity for students to share/present learning
  3. debrief team effectiveness

- **Optional activities**

- **Career Applications**
  1. Teamwork skills
  2. Environmental monitoring for athletics, industrial applications, or emergency operations

LAB TITLE: Measurements of Temperature in Air, Liquids, and Humans
STUDENT INSTRUCTIONS:

1. **Statement of problem addressed by lab**
    1. How do you measure the temperature of air?
    2. How do you measure the temperature of liquid?
    3. How do you measure a person's temperature?
    4. How are units of measure recorded differently in Europe or Canada than they are in the United States

2. **Grouping instructions and roles**
    1. Work with your assigned partner in the role(s) assigned.
    2. Leader / time keeper will direct action and monitor available time
    3. Measurer / observer will apply the measuring instrument and provide the measure to be recorded
    4. Statistician will record results (if not available, leader is responsible for this task)
    5. All team members should concur on measure obtained by measurer / observer

3. **Procedures** – steps to follow/instructions
    a) Present the various types of thermometers
    b) All teams will complete every station
    c) The station a team starts at is not important, but all teams must progress from station to station sequentially
    d) Use the following station procedures at the appropriate station (station procedures provided on the opposite side)
        a. Station 1: Reading measures of air temperature
        b. Station 2: Measuring warm and room temperature liquids
        c. Station 3: Measuring cold and cool liquids
        d. Station 4: Measuring oral temperature
        e. Station 5: Measuring skin temperature (and tympanic if available)
    e) Record all measurements on the Lab Data Collection sheet and circle measured in all boxes where measurements were observed during the experiment, as opposed to being calculated mathematically.

4. **Outcome instructions**
    1. Demonstrate teamwork and have fun
    2. Complete one chart for your team

5. **Assessment instructions** (peer-teacher)
    Your teacher will be monitoring your teamwork skills during the various activities. Team performance will be added to the results of the worksheet received from your team.

Station Legends:

Reading measures of air temperature

You are the meteorological team for a national forest service wilderness fire command group. You are responsible for determining the current environment and predicting future trends. You take measurements on temperature, humidity, wind, and precipitation (rain fall). Right now you need to get an updated temperature reading.

Measuring warm and room-temperature liquids

You are a team of chefs at a premier restaurant in New York City. You have various soups and sauces with different temperature requirements for optimal taste. Your restaurant is being reviewed later today by a critic from the Food Network with her film crew. You need to accurately monitor the temperature of two of your soups. One is served hot while the other is prepared hot but served at room temperature.

Measuring cold and cool liquids

You are a team of biochemists researching a cure for cancer. Your current experiment involves preparing liquids below room temperature. In order to accurately document your research you need to confirm the temperatures of the liquids regularly.

Measuring oral temperature

You are nurses and physicians who work in Haborview Medical Center's burn center. You work with all sorts of burn injuries and know that accuracy is sometimes more important than immediacy. After reports from the emergency room that they have had concerns about the accuracy of their digital thermometers, you have decided to evaluate differences between digital and bulb thermometers.

Measuring skin temperature

You are Exercise Physiologists studying the effects of temperature on athletic performance. You need a quick measure of temperature that also has a decent degree of accuracy and precision. You are unable to use oral temperatures because of safety concerns of measuring sequential temperatures of athletes while they are exercising, on a stationary bike.

Station Procedures:

1. **Reading measures of air temperature**
    1. Identify, read, and record the temperature from each of the following thermometers as accurately as possible.
        a. Spring thermometer (circular / dial)
        b. Bulb thermometer (line / column)
        c. Digital thermometer
        d. Galileo thermometer (if available)
    2. Complete the other stations before answering the questions.
2. **Measuring warm and room-temperature liquids**
    1. Identify the dial cooking thermometer and use it to measure both cups of liquid. Record the temperature.
    2. Identify the digital cooking thermometer and use it to measure both cups of liquid. Record the temperature.
    3. Complete the other stations before answering the questions.
3. **Measuring cold and cool liquids**
    1. Identify the spring (circular) cooking thermometer and use it to measure both cups of liquid. Record the temperature.
    2. Identify the digital cooking thermometer and use it to measure both cups of liquid. Record the temperature.
    3. Complete the other stations before answering the questions.
4. **Measuring oral temperature**
    1. Identify the oral bulb thermometer. An anal bulb thermometer, if present, will be distinguishable because of its shorter and thicker bulb.
    2. The measurer should prepare the oral bulb thermometer for use by shaking it as previously shown, then apply a thermometer sleeve and insert it under their own tongue for 1-3 minutes. Record the temperature.
    3. Identify the oral digital thermometer. The measurer should prepare the oral digital thermometer for use by applying a thermometer sleeve, pressing the button, and inserting it under their own tongue until the thermometer beeps. Record the temperature.
    4. Complete the other stations before answering the questions.
5. **Measuring skin temperature**
   Skin temperature can be taken with oral thermometers, though they will not be as accurate as when used orally due to calibration.
    1. If available, identify the temporal thermometer. This sensitive device measures the infrared radiation emitted by your skin. The statistician or group leader should apply the metal head to the measurer's temple and press the button. Record the temperature.
    2. If available, identify the tympanic thermometer. This sensitive device measures the infrared radiation emitted from your ear canal. The statistician or group leader should apply a tympanic thermometer cover, gently insert the probe to a measurer's ear canal and press the button. Record the temperature.
    3. Identify the oral or anal bulb thermometer. An anal bulb thermometer, if present, will be distinguishable because of its shorter and thicker bulb. The measurer should prepare the bulb thermometer for use by shaking it as previously shown, wipe the thermometer with an alcohol wipe, and insert it under their own armpit for 1-3 minutes. Record the temperature.
    4. Complete the other stations before answering the questions.

Lab Data Collection

Student: _____ **Date:** _____

Unit: 3 Measuring in English and Metric Units

Lab Title: **Measurements of Temperature in Air, Liquids, and Humans**

Criteria: Write the problem/objective in statement form

Data Collection: Record the collected/given data

1) Station 1: Reading measures of air temperature

	Date & Time	Measured by	Fahrenheit	Celsius
Spring Thermometer				Calculated
Bulb Thermometer			Measured Calculated	Measured Calculated
Digital Thermometer			Measured Calculated	Measured Calculated

a) Were all measurements equally accurate? Why or why not

b) Were all measurements equally precise? Why or why not

2) Station 2: Measuring warm and room temperature liquids

	Date & Time	Measured by	Fahrenheit	Celsius
Liquid 1 Spring Thermometer			Measured Calculated	Measured Calculated
Liquid 1 Digital Thermometer			Measured Calculated	Measured Calculated
Liquid 2 Spring Thermometer			Measured Calculated	Measured Calculated
Liquid 2 Digital Thermometer			Measured Calculated	Measured Calculated

a) Were both instruments equally precise? Why or why not

3) Station 3: Measuring cold and cool liquids (continued on back)

	Date & Time	Measured by	Fahrenheit	Celsius
Liquid 1 Spring Thermometer			Measured Calculated	Measured Calculated
Liquid 1 Digital Thermometer			Measured Calculated	Measured Calculated

Liquid 2 Spring Thermometer			Measured Calculated	Measured Calculated
Liquid 2 Digital Thermometer			Measured Calculated	Measured Calculated

a) Were any of the temperatures surprising? Why or why not

4) Station 4: Measuring oral temperature

	Date & Time	Measured by	Fahrenheit	Celsius
Bulb Thermometer			Measured Calculated	Measured Calculated
Digital Thermometer			Measured Calculated	Measured Calculated

a) Were both instruments equally precise? Why or why not

5) Station 5: Measuring skin temperature

	Date & Time	Measured by	Fahrenheit	Celsius
Temporal or tympanic Thermometer			Measured Calculated	Measured Calculated
Auxiliary Thermometer			Measured Calculated	Measured Calculated

Note: auxiliary temperatures are normally 0.5^0F to 2^0F below oral temperatures.

a) Were these instruments equally precise? Why or why not

b) How do these instruments compare with the oral thermometers for consistency, precision, and accuracy?

Calculations: Complete the given calculations to solve for an answer(s)

Calculate values for any blank boxes in the Fahrenheit and / or Celsius columns.

$1^0F = 9/5^0C + 32^0$ $\quad$ $1^0C = 5/9\ (1^0F - 32^0)$

(note the 32^0 in these equations has no Fahrenheit or Celsius value)

Summary Statement:

To be written in your lab book, followed by a classroom discussion.

- Did you enjoy this lab (why or why not)?
- Did you learn or reinforce any knowledge from this unit?
- How did the varying degrees of precision effect the measurement?
- Can you think of any disadvantages of the instruments identified as more precise?
- How would this knowledge apply to your everyday life now or in the future?
- How would you apply this process to other jobs or tasks not already discussed?