Save a copy so that you will then be able to fill out and submit it as your own
Mark your answers in **Blue** or **Green** and **Bold** so it's easier to grade
Save As/Export your file as a PDF and save it for your records
Upload your PDF to the Moodle page to the "Lab #1 Submission" link

PH 104 Name: ________________

LAB #1: Measurement

Part I. Scientific Principles: *Harold and the Orange River*
Objective: The following exercise is designed to give you some practice in determining what appropriate scientific questions to ask are, and proper hypotheses to propose when faced with a problem in the natural world.

Here's the situation. Driving across the Willamette River, Harold notices that it has turned bright orange. Several thoughts run through his mind. Some of these thoughts may be valid steps in initiating the scientific method to solve this mystery, and some may not. Each may be classified as one of the following:

a. an irrelevant observation (has no bearing on the problem)
b. a valid observation
c. an irrelevant question (has no bearing on the problem)
d. a valid question
e. an improper hypothesis (not testable)
f. a valid hypothesis (testable)

1) For each of the following thoughts that runs through Harold's mind, specify (in the blank) which of the above (a. – f.) best describes the statement. There are more statements than options, so using an option twice will occur.

_______ "Hey, the river is orange!"

_______ "I like orange juice."

_______ "Nothing else looks unusual, just the river."

_______ "I don't smell anything unusual."

_______ "I don't hear anything unusual."

_______ "What made the river turn orange?"

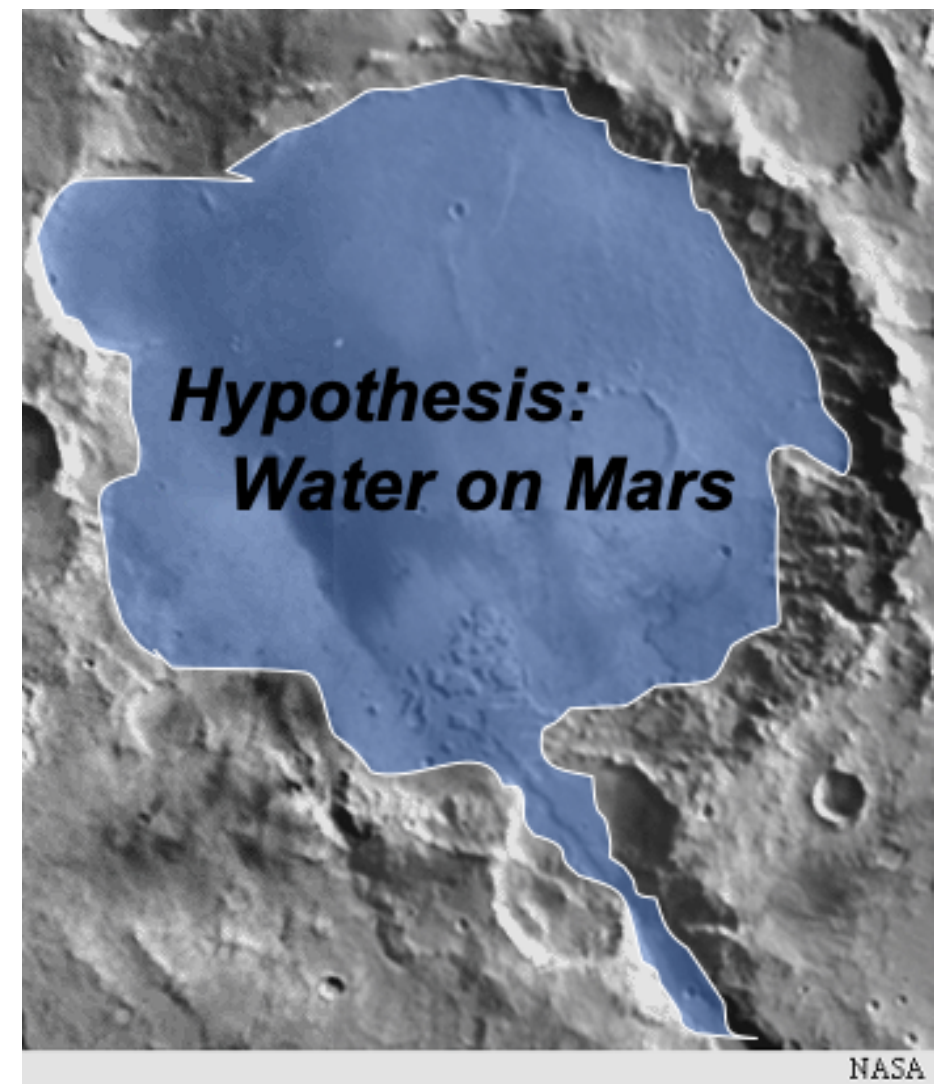
_______ "Will Maude sit next to me in math class today?"

_______ "When did the river turn orange?"

Gusev Crater **observations**:
1. Smooth crater floor
2. Terraces along crater walls
3. Linear channel that intersects the crater

Gusev Crater **explanations**:
1. Lake sediments covered the crater floor leaving a smooth surface
2. The terraces were created by standing water
3. The linear channel was cut by flowing water

Gusev Crater **hypothesis**:
There was once water on Mars.



Gusev Crater **Prediction**: If there is (or was) water on Mars, then maybe there is life.
Gusev Crater **Implications**: If there is life, then maybe we are not alone or maybe Mars could sustain human lives at some point.

_______ "Is the water warmer or colder than usual?"

_______ "It's a magic river. The river has turned orange by itself."

_______ "There must be some form of pollution that has turned the river orange."

_______ "Maybe I've been drinking too much orange juice and now everything will start to look orange to me."

2) If you determined that any of the above were scientifically <u>improper hypotheses</u> (meaning they are not testable), explain why you thought so.

3) Is it possible for a hypothesis to be judged scientifically proper and yet turn out to be ultimately untrue? Explain.

4) Suggest at least one additional valid hypothesis (testable) for why the lake has turned orange and list at least one way that this hypothesis could be tested.

Hypothesis:

Test of hypothesis:

Express the following numbers in scientific notation (including **units**!):

1. The age of the Earth – 4,600,000,000 years: ____________________

2. Mass of a proton – 0.0000000000000000000000000016726 kg: ____________________

3. Mass of an electron – 0.00000000000000000000000000000091093 kg: ____________________

4. Size of the Milky Way galaxy – 90,000,000,000,000,000 km: ____________________

The Scientific Method
Objective: The following exercise is designed to give you some practice working through the scientific method when faced with a problem in the natural world.

The universe is sensible and governed by immutable rules. Our goal is to figure out those rules. We start with observations.

1. Make three **observations** about the Gusev Crater on Mars.

NASA

Dimensions of the Solar System

	Distance from Sun		Diameter	
	AU*	km	Earth Diameters	km
Sun	0.00	0	109.20	1,392,300
Mercury	0.40	59,840,000	0.38	4,846
Venus	0.70	104,720,000	0.95	12,113
Earth	1.00	149,600,000	1.00	12,750
Moon	*1.00*	*149,600,000*	*0.25*	*3,188*
Mars	1.50	224,400,000	0.53	6,758
Jupiter	5.20	777,920,000	11.20	142,800
Saturn	9.50	1,421,200,000	9.40	119,850
Uranus	19.20	2,872,320,000	4.00	51,000
Neptune	30.10	4,502,960,000	3.90	49,725
Pluto	39.40	5,894,240,000	0.18	2,295
Nearest Star	280,000	4.19E+13		

*AU = Astronomical Units (=Earth's distance from the sun)

B. Scientific Notation:
Scientific notation is an easy way to express and do math with very large and very small numbers. In scientific notation, numbers are always written as a power (exponent) of 10 with the form:

$$a \times 10^{b}$$

where **b** (the exponent) is an integer and **a** is a decimal number between 1 and 10. On most calculators, a number like 5.7×10^{6} will appear as 5.7E6. You can think of the exponent as equal to how many decimal places you move the decimal point to make the "a" part a number between 1 and 10. Large numbers always have a positive exponent and small numbers (less than 1) always have a negative exponent.

Examples:

$5.7 \times 10^{6} = 5700000$ $\quad$ $6.5 \times 10^{-3} = 0.0065$

If you need more direction to help with Scientific Notation, I've posted a second document on Moodle below Lab #1 with some information and links to help.

The observations that I made are located at the end of the document. You can check your observations with mine before moving forward to question 2.

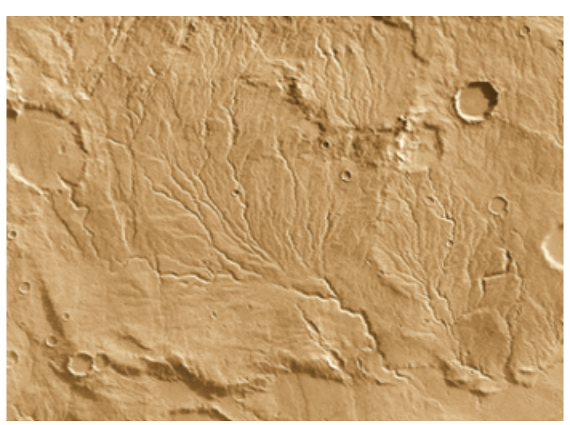
2. Based on your observations, come up with **explanations** for your observations.

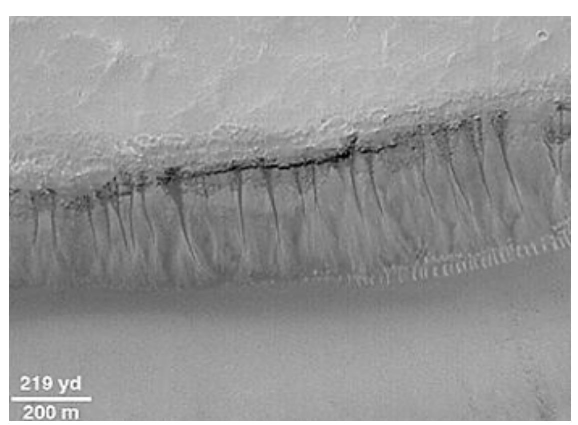
The explanations that I came up with for my observations are located at the end of the document. You can check your observations with mine before moving forward to question 3.

3. Based on your explanations, come up with a **hypothesis** that makes a prediction.

The hypothesis that I came up with is located at the end of the document. You can check your observations with mine before moving forward to question 4.

4. Now we need to verify or dismiss our hypothesis based on observations. Here are two photos taken on Mars. Do these verify or dismiss your hypothesis?





Pictured left: Possibly recent channels. Pictured right: Possibly seeps in canyons.

6. a. If there is (or was) water on Mars, what prediction could you make from your hypothesis?

b. Are there any implications of your prediction? Name one.

As before, my prediction and implications are located at the end of the document.

Part II. Measurement
Objective: To gain insight into the quantitative measurement and observations in science.

A. Putting the solar system into perspective
Suppose we were to build an accurate scale model of the solar system starting with a basketball (24 cm in diameter) representing the Sun. (Note: The Sun's diameter is about 100 times the size of Earth.)

What size diameter sphere would we need to represent Earth: ___________ cm

Suggest a common item we might use in our model to represent Earth: __________________

The distance from Sun to Earth is defined as one Astronomical Unit (AU). In our scale model, 1 AU would be 25 m. Use the table on the next page, "Dimensions of the Solar System," to answer these questions. In our scale model, how far from the basketball/sun would we put:

Mars: ___________________m

Jupiter: ___________________m

Pluto: ___________________m

Proxima Centauri: ___________________m
(the nearest star)

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