Astronomy 101 Lab: Scientific Method

If you own a laptop, please bring it to class. You will read some articles on websites and your answers will be submitted on Cobra using the answer sheet provided on the website. The Stellarium shortcuts you used in the first lab are on the inside cover of your lab packet and on the website.

Pre-Lab Assignment: This is an internet-based lab, where you will discuss various scientific controversies related to astronomy. This lab will also introduce you to the scientific method and two scientific terms: "hypothesis" and "theory."

Before coming to lab, answer the following questions in your own words. **Do not use the definition from the back of the book or from the lab itself.**

A) **What is science?**

B) **What is a hypothesis?**

C) **What is a theory?**

D) Astrology is a different field from astronomy. Astrologers say that your personality is dependent on your birthday and they also predict future outcomes through horoscopes. **Is astrology scientific? Explain your answer.**
**Introduction:** The scientific method is usually stripped down for use in the classroom. The skill is difficult to master because science experiments, unlike classroom labs, aren’t like cookbooks. The answer is not known ahead of time and may only lead to more questions. However, the potential fruits of this work are immeasurable. Reading this on a computer screen is but one aspect of the advances that began 400 years ago.

In many cases, scientific inquiries lead to debate. While the two sides of controversy will have varying levels of support, the only solution is further study. For example, decades of work went into settling the debates on continental drift and evolution. Today, we will examine the evidence brought up by both sides in two issues related to astronomy: the existence of intelligent life on Mars, and the field of astrology, which supports the idea that the heavens exert an influence on our lives.

Several questions will require you to access the internet. You can find these links on the website version of this lab or at this URL. [http://natsci.parkland.edu/ast/101/labs/scilinks.htm](http://natsci.parkland.edu/ast/101/labs/scilinks.htm)

**Answer the questions below in complete sentences. You will submit your answers on Cobra.** Please use the answer sheets at either URL below.

**Controversy #1: Intelligent life on Mars**

If you aren’t sure about the following questions, try an internet search or make an educated guess.

1. **How does Earth show evidence of intelligent life, i.e. a technological civilization, to potential observers from millions of miles away?**

2. **How does Earth show evidence of unintelligent life (such as plants and animals) to potential observers from millions of miles away?**

In case you are not familiar with the story of the "Face on Mars," NASA sent two Viking probes to Mars in the 1970s, returning a wealth of information about the Red Planet. Among the data were photographs of the surface taken from the orbiters, including the region now known as the Face on Mars. In 2001, the Mars Global Surveyor took an image of the same region at a much higher resolution. These images of the Face on Mars are found in the links for Question 3.

3. **Which image looks more like a face, the one from the Viking probe or from Mars Global Surveyor?**

Check the links for Question 4. Read the article about pareidolia ("pair-i-doe-lee-uh"), then look at the examples of natural and artificial pareidolia.

4. **Does the "Face on Mars" constitute evidence supporting intelligent life on Mars? Explain your answer.**

Life on Earth requires nutrients, water and energy; most Earth life also requires other conditions, such as a fairly narrow range of temperatures and atmospheric pressures. Search the internet for information on conditions on Mars to help answer the next questions.

5. **Are the conditions on the surface of Mars currently capable of supporting most life on Earth? Explain your answer.**
Please read both questions 6 and 7, and note the difference between them, before answering.

6. Do you think Mars shows evidence of current or past intelligent life? Explain your answer.

7. Do you think Mars shows evidence of current or past unintelligent life? Explain your answer.

8. Even if Mars shows no evidence of current or past life, does that mean Mars has never had life? Explain your answer.

Controversy #2: Astrology

Astrology means many things to many people. You are probably most familiar with its use in horoscopes. Astrology’s hypothesis is that objects in the sky, such as planets and stars, affect human affairs. Supporters of astrology feel that it can provide special insights into the nature of humans and predict future events. Opponents feel that there is no mechanism to affect human nature or their destinies.

Once again, you may search the internet for more information to help answer the next few questions.

In the scientific method, any valid hypothesis must make a testable prediction. A hypothesis that could not be subject to experiment would not be scientific.

9. Use the basic hypothesis of astrology (see above) to come up with a testable prediction of astrology. How can we test that prediction?

A basic principle of science is that if we see an effect, there must be some force causing it. Astrology is vague on what force might be causing the planets and other heavenly bodies to have an effect on people, though some astrologers have suggested gravity as the force.

Read the article about the gravitational effects of the planets in the link for Question 10. (You can start at "Just how strong is the influence of the planets?")

10. Explain why gravity isn’t a good candidate for an astrological force based on the ideas from the article.

The horoscopes that appear in U.S. newspapers and magazines are from what’s called "natal" or "sun sign" astrology. The premise is that you are influenced by the Sun’s position at the time of your birth; the constellation corresponding to the Sun’s position is called your sign.

11. What is your sign? If you aren't sure, check the list in the link for Question 11.

The Stellarium shortcuts you used in the first lab are on the inside cover of your lab packet and at this URL. http://natsci.parkland.edu/ast/101/shortcuts2.pdf

12. Open Stellarium. What constellation was the Sun in when you were born?

You may have found that the Sun was not in your "sign" constellation on the day of your birth. For example, a person born on the first of May would look up their horoscope under Taurus, but on May 1 the Sun was located solidly inside the constellation of Aries.

13. If you were to find that your astrological sign did not match the Sun’s constellation when you were born, how would this affect your confidence in the predictions of the horoscopes?
The link for Question 14 has two sets of horoscopes taken from two sources on the same day. The horoscopes have been randomly sorted.

14. Pick any three of the horoscopes in list A, and find their closest match from list B. Record each corresponding pair here.

15. Consult the list of the actual pairs of horoscopes in the link for Question 15. How many pairs did you get correct?

16. If both sets of predictions were working from the same basic premise, how many would you expect to get right? Explain your answer.

You may search the internet for more information to help answer the next question.

17. In just one sentence each, summarize both the pro-astrology and anti-astrology viewpoints.

18. Which side of the issue of astrology presents a stronger argument? Explain why you feel their argument is stronger.

As stated earlier, a scientific theory is not the same as a hypothesis. According to Charles E. Long:

"An initial guess is called a hypothesis or speculation. A scientific theory is an explanation of a problem, an explanation that allows us to see connections between seemingly unconnected facts, and to see them in a way that makes sense and gives pleasure. Only after the idea has been fully worked out, only after it is seen to explain many of the observations satisfactorily, and only after it has stood up to the critical analysis of other workers in the field is the word 'theory' conferred upon it." (emphasis added)

19. Do you feel the ideas which support intelligent life on Mars would constitute scientific theories as Charles Long defined them? Explain your answer.

20. Do you feel the ideas which support astrology would constitute scientific theories as Charles Long defined them? Explain your answer.

21. If these ideas are not considered scientific theories, does this mean that they must necessarily be wrong? Explain your answer.