

INTRODUCTION TO NIGHT LABORATORY

Introduction

Throughout recorded history, and probably long before, people have watched the sky, seeking comfort in its apparent permanence, but searching for guidance in its changing aspects for planting of crops, celebration of holidays, or the collection of taxes. Some of the patterns are obvious; the passing of day and night and the change of the seasons are so self-evident that we rarely pause to think how fundamentally they regulate our lives. Less evident to modern city dwellers are the phases of the moon, the motions of the planets or the changing aspects of the constellations.

As beautiful as a sunset may be or as awe-inspiring as an eclipse of the Sun is, these events are no longer mysterious. But think of a farmer of 5000 years ago, who had no clocks or calendars, but still had to know when to plant or to harvest the crops. In those times, people realized, far more than they do now, how important the celestial cycles are to our lives and survival.

Inevitably, the human mind seeks to learn the patterns in nature and then to understand their meaning. The history of Astronomy is a story of the discovery of the sky, its cycles and our place in the universe.

A. The Nature of Science

Science (and Astronomy in particular) is not at all a static body of knowledge; it is a dynamic, changing activity, continuously building on what has gone before. In order to learn about science therefore, it is not enough simply to attempt to memorize a body of knowledge --- you must also experience, as much as possible, the doing of science.

A common misconception is that scientists either sit alone and somehow gain inspiration (the image of Newton under the apple tree comes to mind) or they pour random materials together hoping to concoct new substances. Neither idea is even close to the truth. New theoretical ideas are always a synthesis of previous ideas and experiments. Experiments are always designed to test some specific idea. The results of the experiment may be unexpected and may give rise to completely new ideas, but the original purpose was the probing of an existing theory.

The purpose of these exercises is to teach you something of the process of doing science. All of these exercises have been done before of course, but the actual measurements and observations will be yours. Presumably most of them will lead to the expected results, more or less; probably several of them will become hopelessly muddled for one reason or another. This is **exactly** what one expects to find from “real” experiments being done for the first time.

B. Astronomical Observations

Although astronomical observations are similar in many respects to laboratory experimentation in other sciences, there are some important differences. The major difference is that an astronomer cannot generally control the course of the experiment or bring the subject into the lab. It is necessary simply to observe --- we are at the mercy of the phenomenon we wish to study. We cannot make a comet appear at any time but instead we must wait for one to appear. Nor can we bring a piece of a star into the lab for chemical analysis, but we must look at it from afar. These obvious, but fundamental, facts affect the style of observational astronomy as compared to, say, experimental physics or chemistry. Nevertheless, the basic goals are the same --- to learn about the nature of the universe in which we live.

Those of us who are professional astronomers enjoy going out at night to study the universe. Nevertheless, it can be difficult work; especially on a cold winter night the night seems to last forever. Adding to the discomfort is the frustration of dealing with the weather; it may take many nights before the weather cooperates. The weather can be particularly frustrating to beginning students, who typically will have only a few chances to make their observations. Diligence is the key to success. If there is a good night coming **do not put off your observing** --- you may not get another chance.

Another difficulty that you will notice immediately is that the city lights overwhelm the faint stars; in our modern world, few people can see the stars in their full glory. Because of the brightness of the night sky, you will not be able to pick out the constellations as well as people used to do, and even with a telescope, faint nebulae and galaxies will be something of a disappointment. Astronomers in fact talk about “light pollution” and build observatories on distant mountaintops, far from the city.

C. Practical Considerations

Since the whole point of these exercises is to give you a feeling of what it means to *do* science, your success will depend to a large extent on active and regular participation. A careful and complete job in taking notes of what you have done will be a major help in ensuring a good grade for the course. Keeping good records is also an essential aspect of doing any scientific work. Remember also that many observations can only be made once, and you may not always realize what is useful until later, so you must record everything that may possibly be relevant and useful. Most of the time, the data pages at the end of this lab book will guide you as to what sorts of information you should include, but you should not hesitate to make note of anything else that seems relevant.

Because astronomical observations are affected so strongly by the conditions of the sky, you should always record the weather conditions before doing anything else. All factors that appear to be relevant should be recorded, including any changes that may occur during your observations. At the very least, the following information should be included:

- the date
- starting time
- ending time
- wind
- temperature
- sky conditions (clear, cloudy, hazy, etc.)
- the moon (phase and location, if visible)
- additional comments

Whenever you come to the observatory or lab sections you should bring the following:

1. Your lab book;
2. Two pens.

For the night labs you should also bring:

3. A small flashlight;
4. Your star atlas or night sky guide or star wheel;
5. **WARM CLOTHING ON COOL AND WINTER EVENINGS.**

One cannot stress this last item too much. On a winter night, an observatory can seem like the coldest place on earth. Several layers of clothing and **WARM BOOTS** are essential.

D. Lab Reports

The data you will gather for these exercises will be entered onto your data pages, (notebook paper is fine). In general, you must have each data page initialed by one of the instructors. In preparing your report for any labs, keep in mind the following goal: *If you read the report in six months, it should be possible to reconstruct what was actually done and what the principal conclusions are.*