Imaging the Moon: Observation & Analysis

(a two-week lab for non-majors)

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Abstract:
The non-majors astronomy course at Kwantlen University College has a weekly lab component. Attempts are made to ensure that the labs represent real data and measurements in order to give the student a genuine science experience. We present a particularly successful, two-week series of labs involving real sky observations of the Moon, in which students make telescopic observations and analyze their own images recorded on 35mm film. Students also work through the logistical steps of telescope time assignment and scheduling, keeping to the schedule and dealing with the uncertainty of weather, all in a way reminiscent of research observations. The entire lab is performed using inexpensive, widely available equipment for amateur astronomy. Because there is no need for a campus observatory, this lab can be replicated at a wide variety of insitituions.

Background:

- Kwantlen University College is a comprehensive community college with university transfer courses and a selection of its own bachelor degree programs.
- Astronomy 1100 is an introductory course for non-majors, filled typically with Arts and Business students.
- The course includes weekly labs.
- The labs described here are two linked labs,
  (1) Observations and
  (2) Analysis
- Students have the opportunity to experience the joy and frustration of observing and to make measurements from their own images.

Why the Moon?
The idea is to observe a real sky object. The Moon is big and bright, within the abilities of the students to make careful observations.

Logistics: How are the observations organized?
We need three (four?) conditions to be met:

- the Moon is up.
- the Sun is down.
- (the student is up, i.e. evening hours, rather than early AM)
- the sky is clear

For approximately one week out of each lunar cycle, the Moon is visible all evening.
Students sign up for an observing shift for each of these potential nights and prepare to observe each night.
Instructor decides each day whether or not the night will be clear. Makes announcement by voicemail.
We keep trying each night, until the first clear night. Then we observe.

Equipment:
No special equipment is required. (i.e. no campus observatory)
This entire exercise can be performed using widely available amateur equipment [see photo].

1. Small telescope. We use 8"instruments (~$1000) which are larger than needed.
2. 35 mm camera and cable release. Our institution owns dozens of them for use by photography students.
3. Connecting hardware. "T-adapter" and "T-ring" (~$60)

The set-up:

- Students report to the lab in groups of four.
- Each group has a 50-minute shift.
- The shifts overlap so that the entire class finishes in one evening.
  e.g. Group 1: 19:00 → 19:50
  Group 2: 19:20 → 20:10

First 30 minutes:
Students are not yet on the telescope.

1. Students are assigned a camera and a roll of film (We find it worthwhile to watch the film being loaded. Many students today have never wound film manually.)
2. A group picture is taken. This helps us identify the film later (otherwise they all look the same).
3. Students make a naked-eye sketch of the Moon. (Useful for orienting the photographs.)
4. Eyepiece observation is also done.
5. An observation log is prepared in the lab notebook.

6. Students can also observe an earlier group taking exposures.

Final 20 minutes:
Students are now on the telescope.

1. The camera is mounted on the telescope. Frame and focus are adjusted.
2. One frame is taken at each shutter speed available (1 s, 1/2 s, 1/4 s ... 1/1000 s) to explore the effects of exposure time.
3. Repeat as time allows. (It almost always does.)
4. Film is unloaded (again, watch students) and turned in for processing.
5. Students must summarize the night's work ("conclusion").

Analysis:
This part of the lab is normally done during the week or two following the observations. The film will have been developed and prints made. (We use the standard "1-hour photo" stores.)

Observation Report:
Students must match their prints with their negatives and the information on their observing logs. They also comment on the observing conditions and any problems they may have had. Problems may include streetlights, trees in the field of view, clouds passing overhead, etc. Students decide which exposure times were most effective and why. They compare their results with those of other groups.
Using a lunar globe or a map, students identify and label the features seen on their photographs. (This task is not as easy as it sounds.)

Measurements:
With any astronomical observation, some sort of measurements should be made. In the case of these labs and in keeping with the skill level of the students, the sizes of craters are measured. Students first establish a plate scale using the known diameter of the Moon and its diameter on the photograph. Then, sizes measured on the photograph can be converted to projected distances on the lunar surface. As a last step, students must compare each measured object to some geographical feature on Earth (e.g. "crater XYZ is about the same size as Lake Erie").

Discussion:
The observation part of the lab is a fast-paced evening and fulfilling for the students and instructor alike. Although it seems like a logistical nightmare, it runs smoothly once the details are worked out.
Students have consistently reported enjoying making the observations and learning that measurements can be made from their own photographs.

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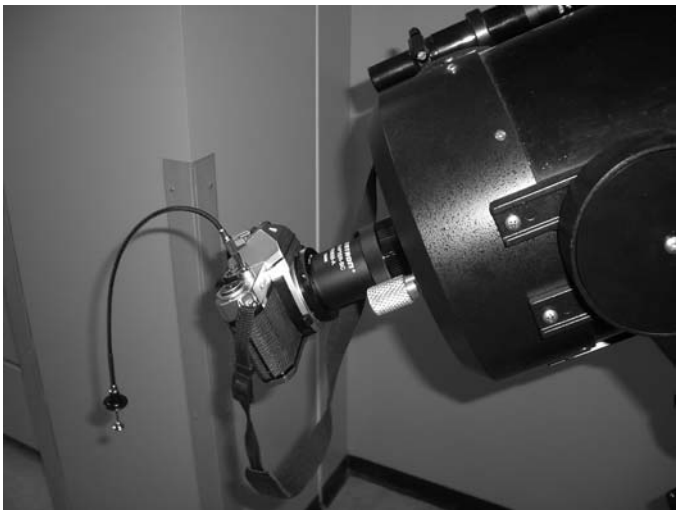

A copy of this handout and our lab manual with detailed instructions for the student is available on the web at http://www.kwantlen.ca/~sci/phys/sato/cosmos2004.html (or go to http://www.kwantlen.ca/physics and follow the links).

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