Name(s) ______________________________ Section Day/Time ___________

OBSERVING PROJECT
PARTNER ELECTION

Fill in either Part 1 or Part 2.

Part I. SOLO OBSERVER

I will do the observing project by myself. I will not copy someone else's paper or show my results to someone else so that they can copy them.

[sign] ____________________________________ Date _________________

Part 2.

AGREEMENT TO DO PROJECT TOGETHER

By signing below, we agree to do our observing project together. We agree that:

1) We will both do a substantial amount of work on the project.

2) We will both take responsibility to have the project checked every week.

3) We will both take responsibility to turn the project in on time.

4) We agree to receive the same grade on the project.

[sign] ____________________________________ Date _________________

[sign] ____________________________________ Date _________________

PROJECT #1: SUNSET

Rules: 1) Do the project by yourself or with one other person. If you want to work with a partner, get an agreement form from the instructor and turn it in next week.
2) Bring your project to class every week to be stamped and checked.
NO STAMPS, NO CREDIT
3) Turn in your completed project on or before Friday, **Oct. 20.**
If working with a partner, turn in only one report with both your names on it.

Overview: The purpose of this project is to test the idea that the Sun always sets exactly in the west. You will observe the Sun set once a week for four weeks. You will be looking for changes in the time of sunset and the direction of the setting Sun.

Equipment: Protractor, watch or cellphone for getting the time. Optional: magnetic compass.

Preparation: Before making your first observation, you will need to select a suitable observing site. Find a spot on a street the goes east-west, such as Manhattan Beach Blvd. or Torrance Blvd. A good location will be a place that is easy to get to but has a fairly clear view of the western horizon, but where there are buildings or poles against which to observe the setting Sun. *Avoid trees. Avoid the beach.* On the El Camino campus, the corner of Manhattan Beach Blvd. & Crenshaw is a good spot. Wherever you are, you need to find a pole or tree to mark your observing location and ensure that you are always in exactly the same spot. *You need to be touching your pole while making your observations!*

Before making your first observation, sketch the horizon as seen from your pole or tree. Make your sketch on page 3. The scale on the bottom of the diagram is the azimuth. **Azimuth** is the direction around the horizon. 180° is due south. 270° is due west. 360° is due north.

You should draw buildings, poles, and fences you see. You need objects in the foreground to serve as reference points. Put your protractor o n the ground with 90° pointing due west; this is 270° on the diagram. Draw what you see due west. Sight 30° to the right of west. Draw what you see at 300° on the diagram. Sight 30° to the left of 90°; draw what you see at 240° on the diiagram. Then fill in the rest of the diagram. Draw in pencil.
If your street doesn't run north and south, you may use a magnetic compass to find true north. True north will be 13° west (left) of the compass needle.

(Q 1) What is the location of your observing site? (For example, "the corner of Crenshaw Blvd. and Manhattan Beach Blvd.")

Hypothesis

Answer before you make your first observation.

(Q 2) Predict how the **direction** of azimuth will change from week to week (to the left, the right, or no change).

(Q 3) Predict how the **time** of sunset will change from week to week (earlier, later, or no change).

Procedure:

If using a watch, check the time on your watch against the official time at www.time.gov before leaving the house or office. Otherwise, use the time on your cellphone. Get to your location several minutes early. Grab your observing pole.

1. Wait till the bright disk of the Sun touches the roof of a building or the horizon. Use your protractor to measure the azimuth of the setting Sun to the nearest degree. Estimate the uncertainty in your measurement (the number of degrees you measurement could reasonably be off) and write it after the "±". For example, if you are pretty sure the true number is between 260° and 270°, write it as: 265° ± 5°.

2. Draw the Sun on your diagram when it is half gone. Draw the Sun's bright disk, not the glow around the Sun. Draw it WHILE YOU ARE WATCHING; don't try to draw it later from memory. DRAW WHAT YOU SEE. Draw the Sun's size as accurately as you can. BE CAREFUL NOT TO MAKE THE SUN TOO BIG. Write the date next to your sun. Draw the Sun **every week**. Draw all of your Suns on the **same** diagram. You should have only one diagram with four Suns on it at the end of the project.

DO NOT ERASE ANYTHING. Since the point is to draw what you see while you are looking at the Sun, erasing invalidates your observation.

If it is cloudy, come back another evening. DON'T GUESS. DRAW ONLY WHAT YOU SEE.

3. Record the time when the Sun's bright disk disappears over the roof or the horizon. Record your time to the nearest minute.

Observations

Record the sunset time in both T-time (PDT) and U-time (PST). Clocks read PDT (Pacific Daylight Time) in **summer** and PST (Pacific Standard Time) in **winter**. PDT is one hour *later* than PST; it is the same as Mountain Standard Time. PST is much closer to the true sun time, which is called **Local Mean Time** (LMT). Calculate the Local Mean Time as well. Use these formulas:

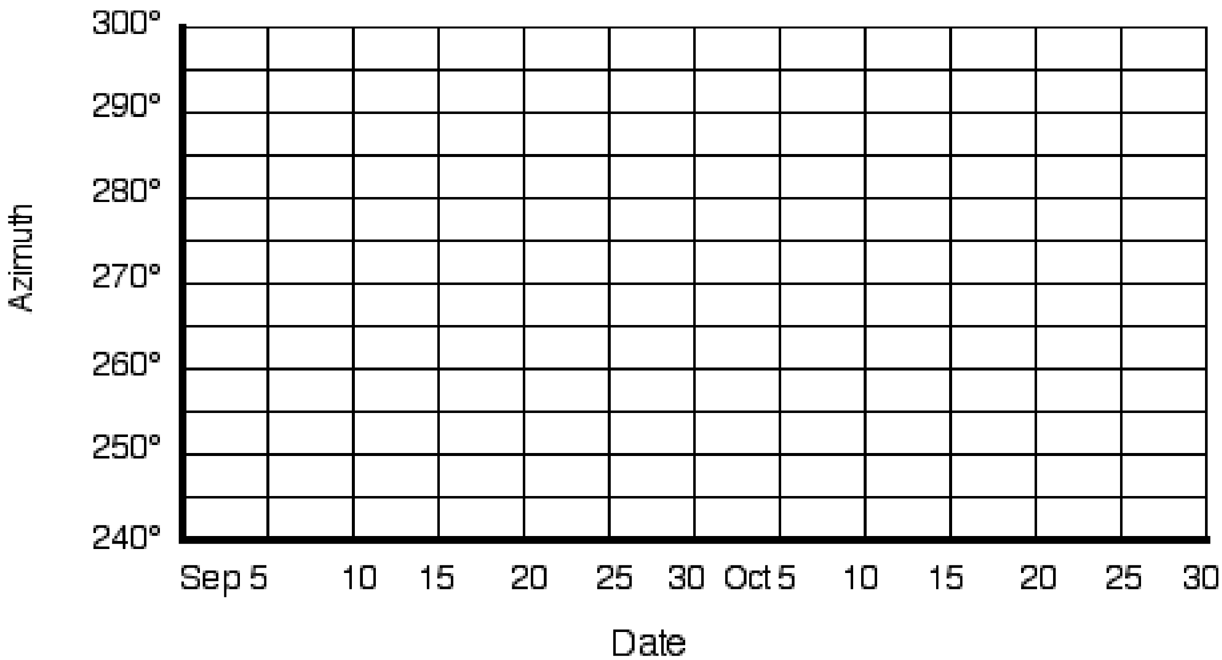
T = PDT = UT – 7 hours = Denver time
U = PST = UT – 8 hours = Santa Barbara time

U = T – 1 hour T = U + 1 hour
LMT = U + 7 minutes = Torrance time

DATE	U TIME (PST)	SUN TIME (LMT)	T TIME (PDT)	AZIMUTH
				±
				±
				±
				±

Azimuth Graph: Plot your azimuth measurements on the graph below. For the azimuth measurements, draw an error bar whose height equals the uncertainty in the measurement through each data point.

Using a ruler, draw a line that goes through the points on your graph. The idea is NOT to connect the dots, but to draw the STRAIGHT line that is *as close as possible* to the dots. USE A RULER. There should be as many dots above the line as below the line. If one dot seems totally out of place, you may ignore it, as it was probably an error, but make sure the others are close to the line.

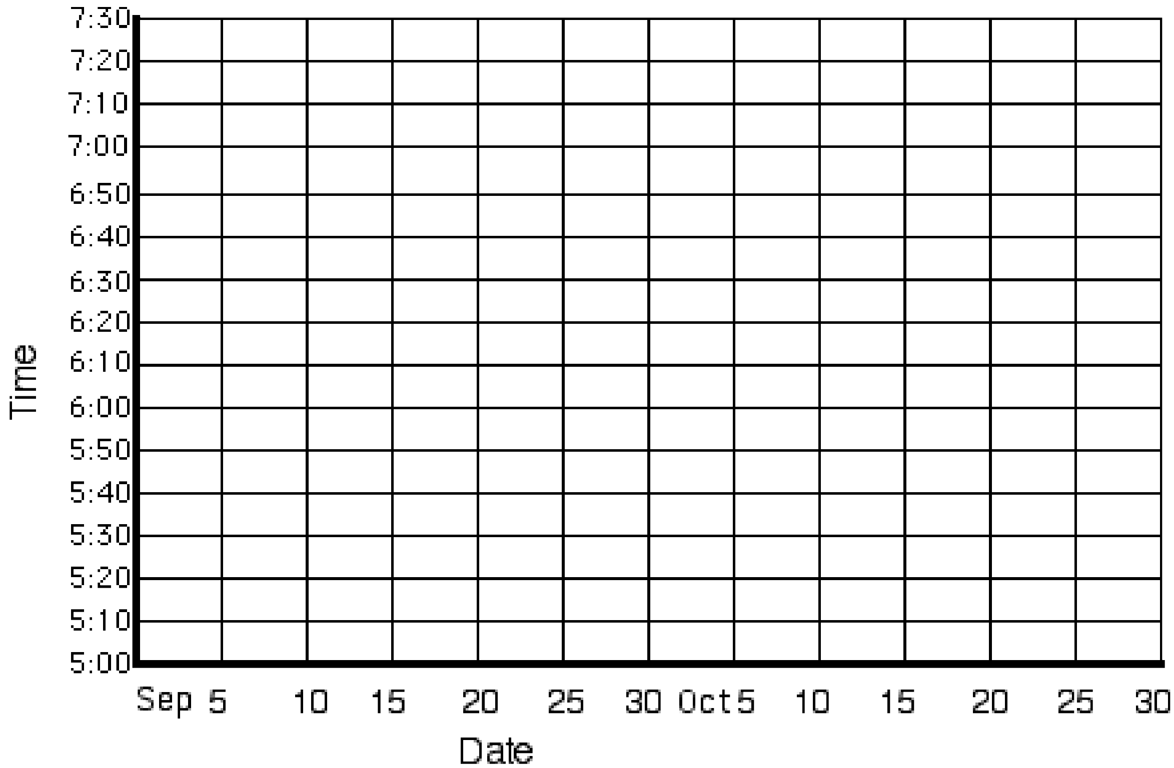


(Q 4) Discuss your azimuth plots. Does it look like the dots fall close to a straight line?

(Q 5) Circle two points **on the line** and use them to calculate the slope of the line as shown on the last page. The slope is the number of degrees per day does the sunset azimuth changes. DON'T USE 2 OF THE DATA POINTS TO CALCULATE THE SLOPE; if you do that, you are ignoring the other points. Show your calculations. Give your result to the nearest tenth of a degree (for example, 2.3°/day). Show the units (degrees/day). **The units are part of the answer.**

(Q 6) What were the causes of uncertainty in your measurement of the azimuth, that is, what difficulties arose while you were making your measurements?

Sunset Time Graph: Plot the sunset times (LMT) on the graph below. Be sure to use **LMT** for all of your time points. This is the true local time.
As you did on the azimuth graph, draw a STRAIGHT line that is as close as possible to the points.



(Q 7) Discuss your time plot. Does it look like the dots fall on a straight line?

(Q 8) Circle two points **on the line** and use them to calculate the slope of the line as shown on the last page.DON'T USE 2 OF THE DATA POINTS TO CALCULATE THE SLOPE; if you do that, you are ignoring the other points. The slope is the number of minutes per day does the sunset time changes. Calculate to the nearest tenth of a minute (for example, 3.5 min/day). Show your calculations. Show the units (minutes/day). **The units are part of the answer.**

(**Q.** **9**) On what day, according to your azimuth graph, does the Sun set due west (270°)? Looking at your time graph, what time does the Sun set that day (LMT)?

Summary of results

(Q 10) *Based on your observations*, what can you conclude about how the direction and time of sunset changes at this time of year? Were your initial hypotheses confirmed? How many sun diameters does the sunset point move each day? (The Sun is 0.5° in diameter.) GIVE NUMBERS. If you say something changes, be precise: explain how fast and in what direction it changes. Be as precise as you can. You are making a scientific report; just give the results of your observations. This is not the place to describe your feelings, hypotheses, guesses, or internet research. YOUR GRADE FOR THE PROJECT DEPENDS ON HOW WELL YOU ANSWER THIS QUESTION.

We/I learned that...

(Q 11) What would you do next to continue your research?

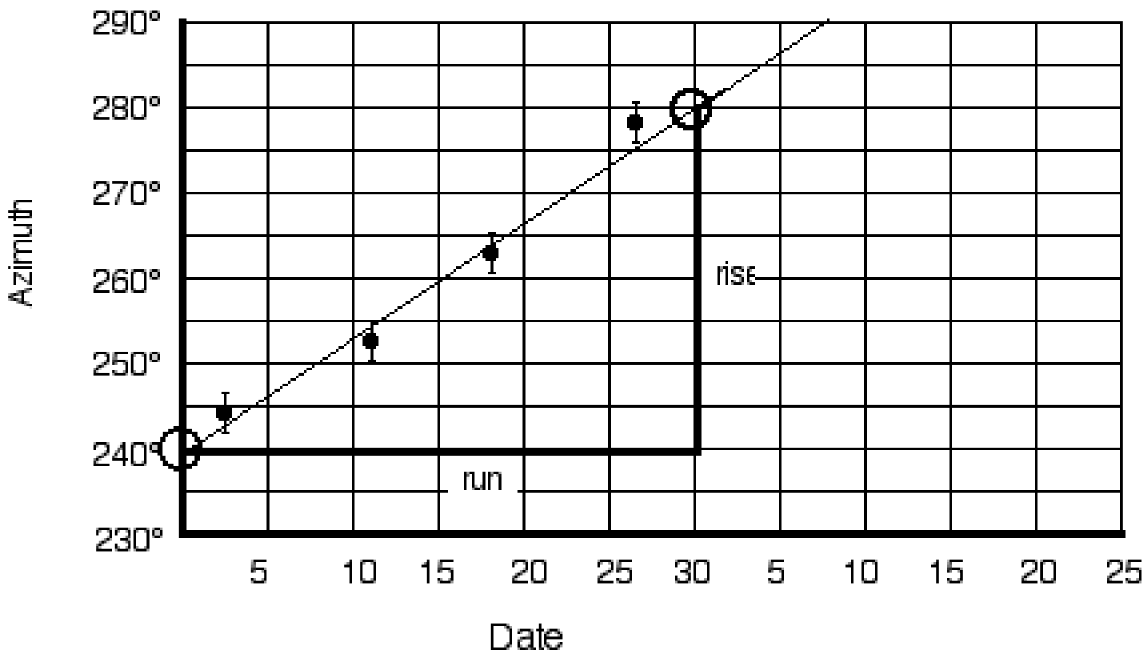
Grading rubric

Observations: number and carefulness	25
Calculations and graphs	15
Questions	10
Total points	50

(20 April 2017)

<u>How to calculate the slope</u>

1. Draw a straight line on your graph, using a ruler. The reason for doing this is that in nature many phenomena follow a straight-line trend. One of the first things a scientist looks for is whether the data fall on such a straight line. *Do not attempt to connect the dots.* Instead, draw a straight line with your ruler in such a way that it is close to most of the dots and there are as many dots above the line as are below the line. This is the best-fit line. Extend the line all the way to the left and all the way to the right.



2. The slope of the line is defined is the **rise** divided by the **run**. The run is a fixed horizontal distance; in this case a certain number of days. The rise is the vertical change in the line over that period.

Use two points on the line a month apart to calculate the slope of the line. Use two points on the line, DON'T USE 2 DATA POINTS; doing so amounts to ignoring the other data points. Your run in this example is 30 days.

3. Now let's figure out the rise, which is the azimuth difference between the two circled points (280° and 240°); in this case it is 40°.

4. Now calculate the slope. Round off to the tenth of a degree or minute.

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{(280° - 240°)}{(30-0)\text{ days}} = \frac{40°}{30\text{ days}} = 1.3°/\text{day}$$