Name _____   Date _____

WHERE'S THE MOST SUNLIGHT?

Introduction:
If you travel today to another location on planet Earth (unless it is the fall or spring equinox), you will find that some places have the same number of daylight hours as Long Island, some places have more hours of daylight, and some have fewer hours of daylight. As you saw in Worksheet #1, the number of hours of daylight on Long Island changes during the year. That is true of most places on the planet. The exception is places on the equator. They always have 12 hours of daylight. How boring! In addition, the height of the sun (altitude, which is measured in degrees) above the horizon may be different from place to place around the globe.

Problem:
On a particular day, how do the sun's altitude above the horizon at 12:00 noon and the number (duration) of daylight hours compare at different latitudes?
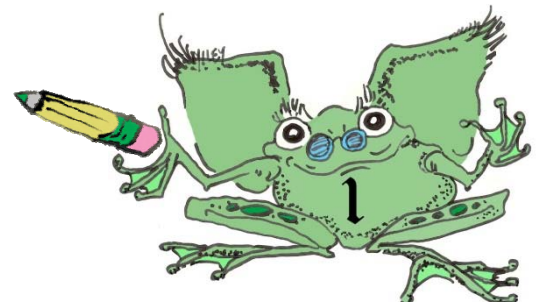
Procedures:
You will again use the simulation at
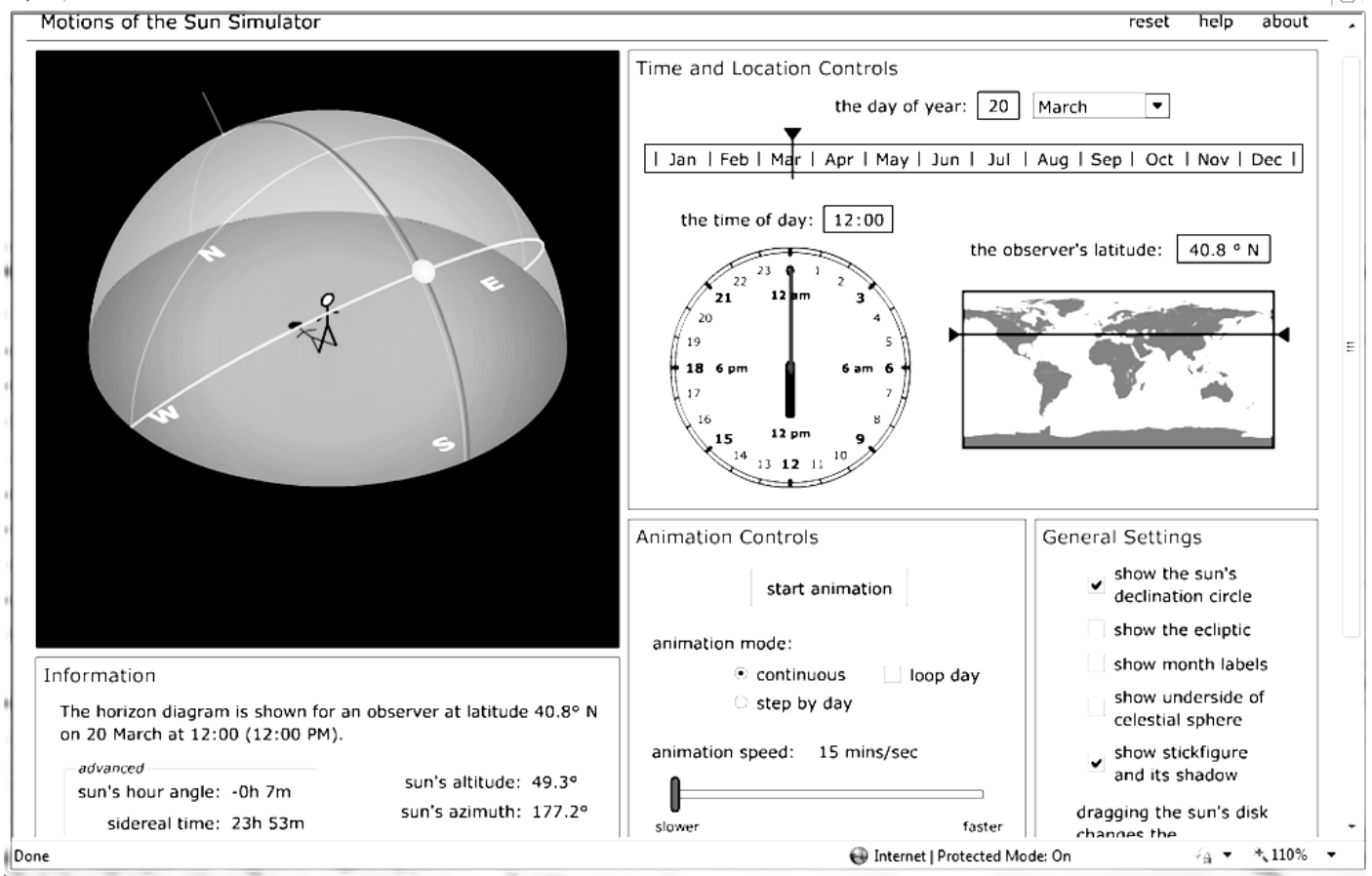http://astro.unl.edu/naap/motion3/animations/sunmotions.html.
Go to the site.

Look at the controls on the right-hand side and set them as you did for Worksheet #1:
- ☐ Under General Settings, check the boxes for:
  - o show the sun's declination circle
  - o show stick figure and its shadow
- ☐ Put the animation mode on "continuous" and the animation speed on its slowest setting.

Motions of the Sun Simulator

reset   help   about

Time and Location Controls

the day of year: [20] March ▼

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |

the time of day: [12:00]

the observer's latitude: [40.8 ° N]

Animation Controls

start animation

animation mode:
◉ continuous   ☐ loop day
◯ step by day

animation speed: 15 mins/sec

slower   faster

General Settings

✔ show the sun's declination circle
☐ show the ecliptic
☐ show month labels
☐ show underside of celestial sphere
✔ show stickfigure and its shadow

dragging the sun's disk changes the

Information

The horizon diagram is shown for an observer at latitude 40.8° N on 20 March at 12:00 (12:00 PM).

advanced
sun's hour angle: -0h 7m
sidereal time: 23h 53m

sun's altitude: 49.3°
sun's azimuth: 177.2°

Done   Internet | Protected Mode: On   110% ▼

1. Place the date indicator on January 1 and set the time for 12:00 p.m./noon (12:00 on the 24-hour clock). Put the cursor arrow a little beyond the end of December, click, and hold. Watch what happens to the altitude of the noon sun as the months go by. Watch it several times and describe how the altitude changes.

   When is the altitude highest? _____

   When is the altitude lowest?_____

2a. Set the time to 12:00 noon and the calendar date to March 20. Set the latitude to 0° or type in 0° in the observer's latitude window.

2b. What is the altitude of the noon sun? Read it from the information box under the animation diagram. Record the altitude in the data chart in column B.

   _____

2c. Determine the time of sunrise and the time of sunset on March 20 for latitude 0°. Use the same procedures you used for Worksheet #1. Put the times on the chart (columns C and D)
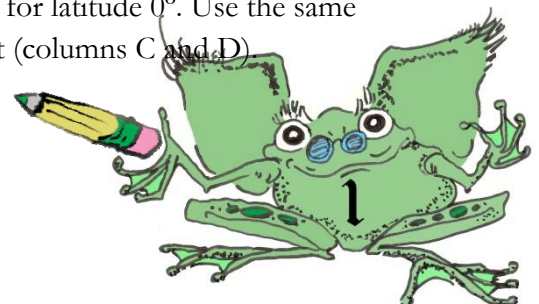
3a. Change the latitude to 10° north or type it in the window and record the new altitude. Add to the data chart.

3b. Find the sunrise and sunset times for 10° north. Add to the data chart.

4. Continue for each of the latitudes shown in the data table.

5. Carefully find the hours of daylight by subtracting the time of sunset from the time of sunrise (column D – column C). This can be tricky. Your teacher may give you some help.
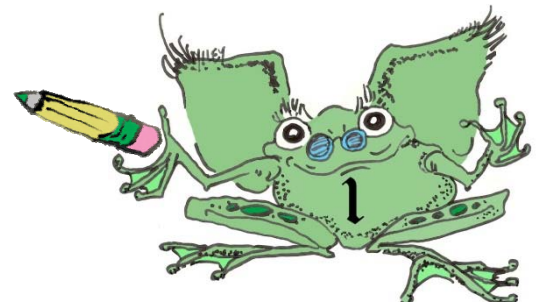
For example:

sunset	19:15	change to	18:75
sunrise	06:27		-6:27
	Hours of daylight =		12:48

6. Convert the hours and minutes of daylight to the nearest quarter hour. Put that in column F.

For example:

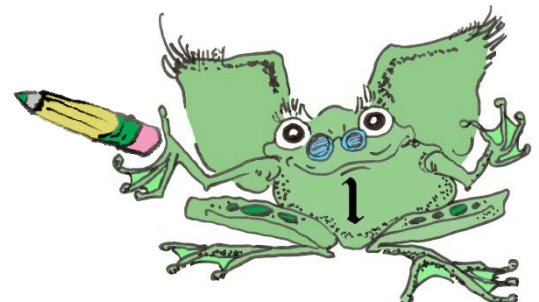|	**Chart :minutes = decimal**
1:15 = 1.25	
1:02 = 1.00	:53 - :07 = .00
1:08 = 1.25	:08 - :22 = .25
11:47 = 11.75	:23 - :37 = .50
13.55 = 14.00	:38 - :52 = .75

This will make it easier to graph the duration (length) of daylight.

Record your data here:

A Latitude (degrees north)	B Altitude at 12:00 noon on March 20 (degrees)	C Sunrise on March 20	D Sunset on March 20	E Hours and minutes of daylight	F Hours and minutes converted to nearest quarter hour
0					
10					
20					
30					
40					
50					
60					
70					
80					
90					

Graph your data:

Make two (2) graphs of the data highlighted in gray:

Graph (1): Latitude and height of the sun
- Label the *x*-axis with "Latitude (degrees north)" — column A.
- Label the *y*-axis with "Altitude at 12:00 noon (degrees)" — column B.
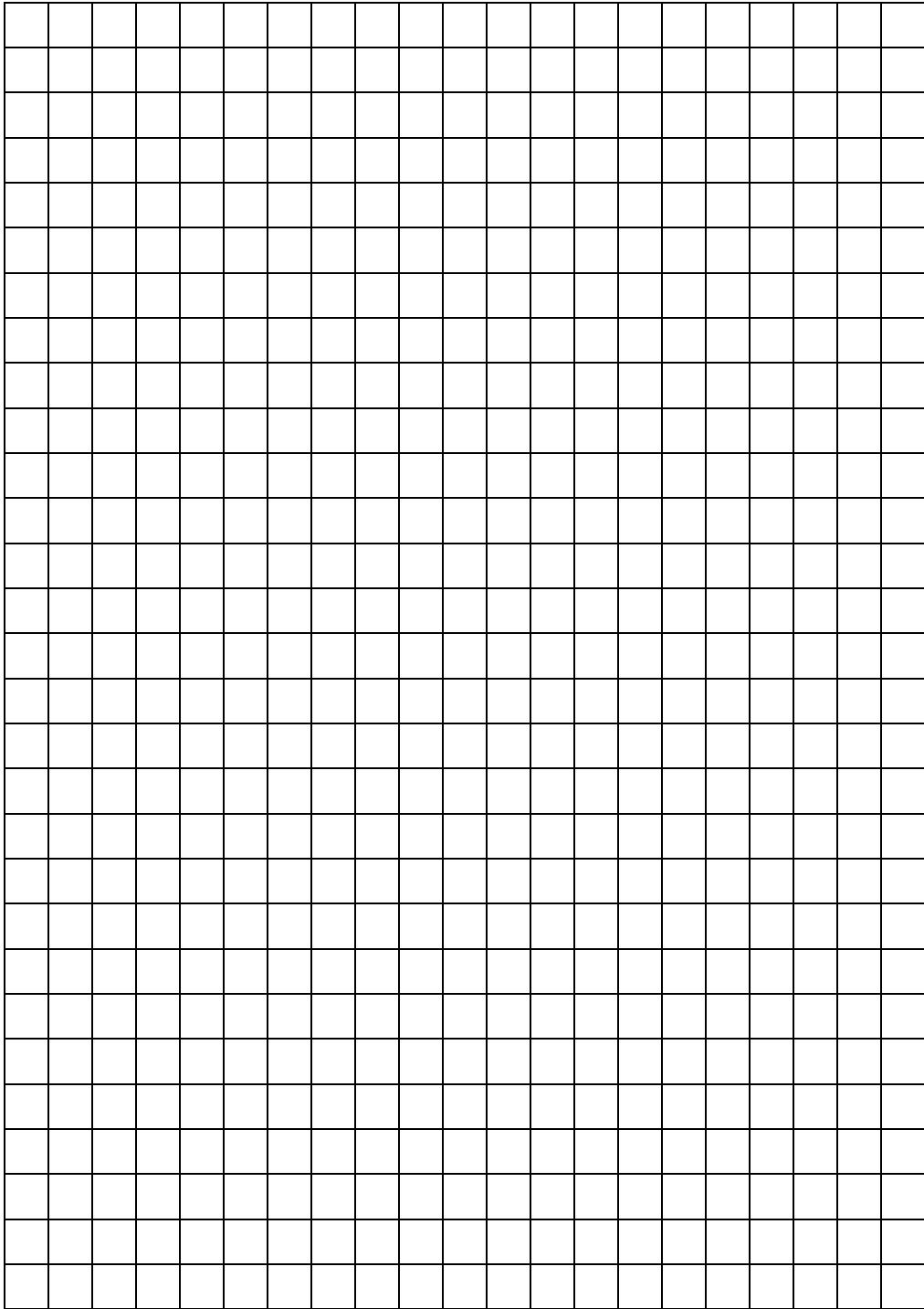- Connect the data points.

Graph (2): Latitude and length of day
- Label the *x*-axis with "Latitude (degrees north)" — column A.
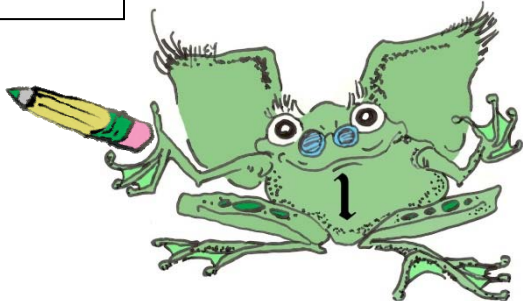- Label the *y*-axis with "Hours of Daylight" — column F.
- Connect the data points
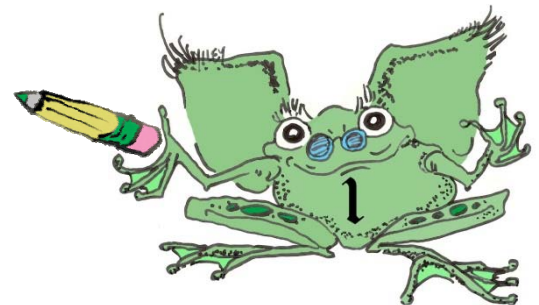
Graph (1): Latitude and height of the sun

Graph (2): Latitude and length of day
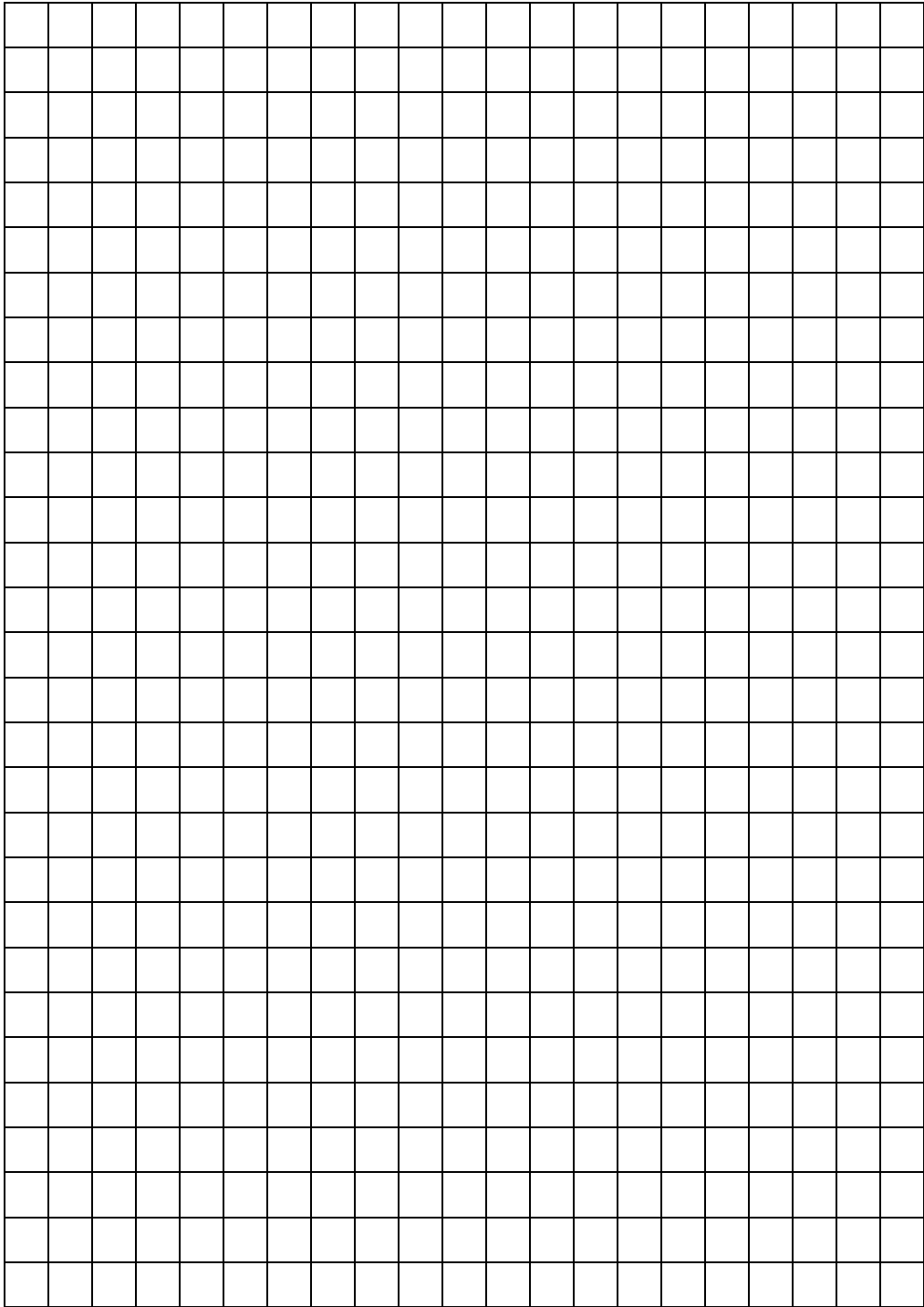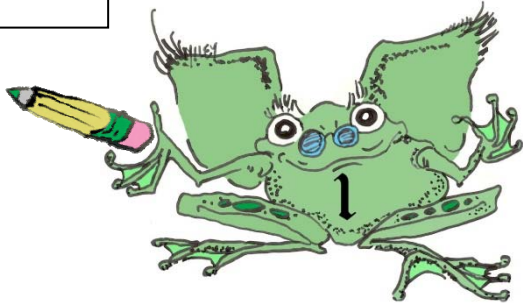
Discussion Questions:

1a. Compare the data for the different latitudes north of the equator: both altitude of the sun at noon on March 20 and the duration of daylight:

Which latitude has the highest sun altitude? _____

Which latitude has the lowest sun altitude? _____

Which latitude has the most hours of daylight? _____

Which latitude has the fewest hours of daylight? _____

1b. Make a generalization about latitude and <u>sun altitude</u> on March 20 by completing this sentence:

On March 20, as the latitude north of the equator increases, the altitude of the sun

_____.

1c. Make a generalization about the latitude and the <u>duration of daylight</u> on March 20 by completing this sentence:

On March 20, as the latitude north of the equator increases, the duration (number of hours) of

daylight _____.

2. From March 20 to June 21, the duration of daylight increases so that all latitudes north of the equator have more than 12 hours of sunlight. Make a prediction by completing this sentence:

On June 21, as the latitude north of the equator increases, the duration (number of hours) of

daylight _____.

3. Use your graph to predict the altitude of the sun at 12:00 noon and the duration of daylight on March 20 at latitude 45° north.

Altitude of the sun: _____   Duration of daylight: _____
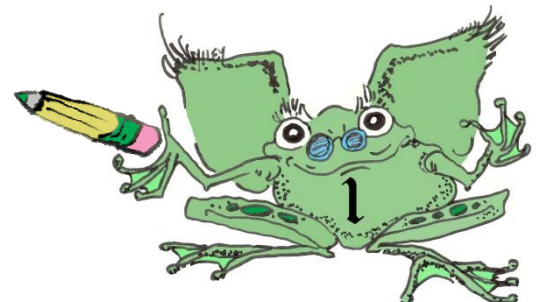
4. How does the angle of the Earth and its revolution around the sun cause different latitudes to have

different sun altitudes at 12:00 noon on March 20?

_____

_____

_____

_____

the amount of daylight that each receives?

_____

_____

_____

_____