

Solar Radiation & Temperature

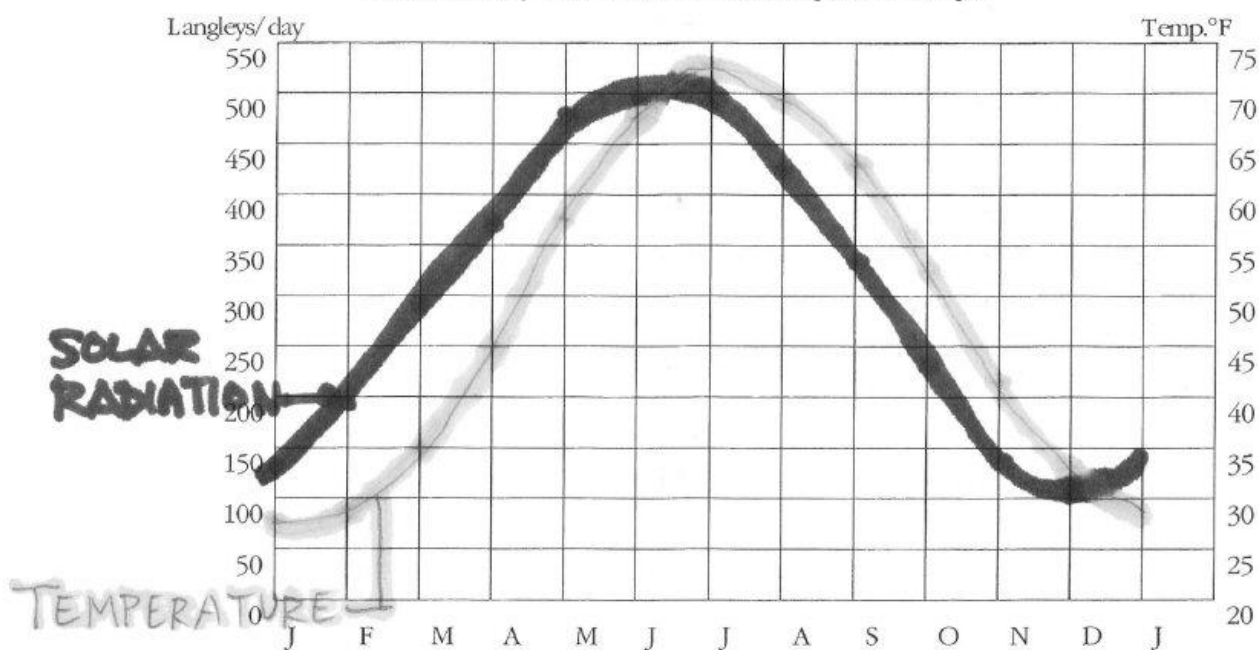
Please show your work. If necessary, please use additional paper to show work.

1) Fill in the blanks below based on the formulas above.

	Place	Latitude	Solar Declination	Zenith Angle	Altitude Angle	Sin(Alt)	Surface Area	% Beam Intensity
1	Salem, MA	43°N	0	43	47	0.731	1.368	73.1%
2	Salem, MA	43°N	23.5°N	19.5	70.5	0.943	1.060	94.3%
3	Salem, MA	43°N	23.5°S	66.5	23.5	0.399	2.506	39.9%
4	Barrow, AK	71°N	23.5°N	47.5	42.5	0.676	1.479	67.6%
5	Barrow, AK	71°N	0	71	19	0.326	3.067	32.6%
6	Barrow, AK	71°N	23.5°S	94.5	-4.5	XXXXXX	XXXXXX	XXXXXX
7	Singapore	1°N	23.5°N	22.5	67.5	0.924	1.082	92.4%
8	Singapore	1°N	0	1	89	1.000	1.000	100.0%
9	Singapore	1°N	23.5°S	24.5	65.5	0.910	1.099	91.0%
10	Cape Town, S.A.	34°S	23.5°N	57.5	32.5	0.537	1.862	53.7%
11	Cape Town, S.A.	34°S	0	34	56	0.829	1.206	82.9%
12	Cape Town, S.A.	34°S	23.5°S	10.5	79.5	0.983	1.017	98.3%
13	Vostok, Antarctica	79°S	23.5°N	102.5	-12.5	XXXXXX	XXXXXX	XXXXXX
14	Vostok, Antarctica	79°S	0	79	11	0.191	5.236	19.1%
15	Vostok, Antarctica	79°S	23.5°S	55.5	34.5	0.566	1.767	56.6%

Shaded = 24 hours of darkness = NO SUN

Mean Monthly Solar Radiation and Temperature Graph



1. Describe the pattern of the insolation curve in terms of *minimum* and *maximum* values during the course of the twelve months of the year.

The curve follows the EARTH/SUN relationship with max values occurring during June (summer Solstice) and min values occurring in December (winter Solstice).

2. Based on the graph and your understanding of sun angles from the prior lab, what is the relationship between insolation values and sun angles during the year?

As the sun angle increases, the energy received increases, thus the insolation increases. ^{WHEN} sun angles increase ~~then~~ insolation values rise and vice versa.

3. Briefly describe the pattern of *mean air temperature values* in terms of minimum and maximum values during the year.

Lowest temperatures are during January and February, while the highest temperatures are present during July and August.

4. Compare the *insolation curve* to the *air temperature curve*. How does the *pattern* differ between the two? (Keep in mind that air temperature is ultimately a result of incoming solar radiation.)

The two curves are very similar. In fact, it seems as if they are almost identical except for a phase difference. The temperature curve ~~changes~~ about 1-2 months after the insolation curve. One, temperature, lags behind the other, insolation.

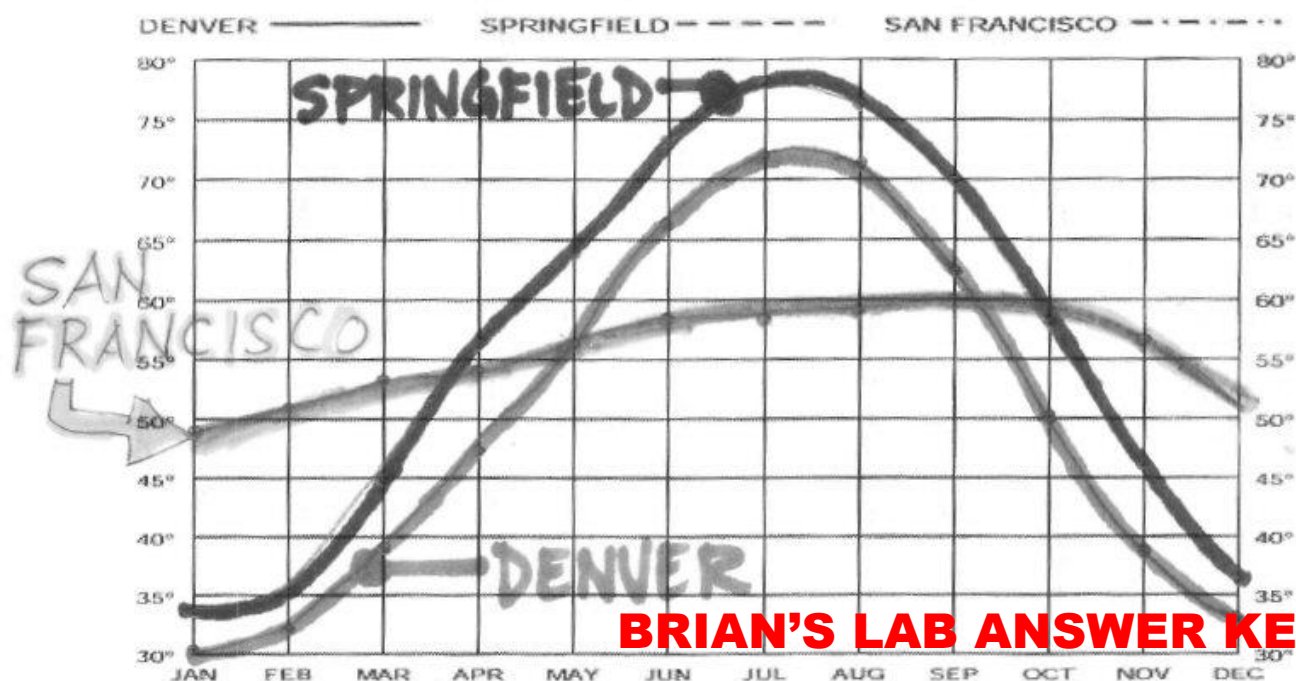
5. Explain why the difference occurs between the air temperature and insolation curves. That is, why is there a lag in the temperature curve? (This is related to the *direct* source of energy heating the air.)

The Sun's energy moves through space and the atmosphere and strikes the Earth's surface where it is absorbed. The Earth takes in this shortwave radiation, then turns it into longer wave, thermal energy, which it sends out (emits) which in turn warms the air causing temperatures to change.

BRIAN'S LAB ANSWER KEY

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TEMPERATURE CHART FOR DENVER, SPRINGFIELD, AND SAN FRANCISCO



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6. Which of the three cities has the greatest variation in annual range of temperature?

Explain the factors accounting for this.

SPRINGFIELD, MO HAS 43° WHILE DENVER HAS 42°. THESE ARE BOTH CONTINENTAL LOCATIONS WITH LITTLE OR NO MARITIME INFLUENCE. HERE, LAND HEATS & COOLS QUICKLY WITHOUT THE MODERATING EFFECT OF WATER.

7. Compare San Francisco's temperature curve with those of Denver and Springfield.

Describe the differences in the San Francisco curve.

SPRINGFIELD & DENVER MAX IN JULY AND MIN IN JANUARY, WHILE SF PEAKS IN SEPTEMBER. THE LOW FOR ALL IS IN JANUARY. BUT THE CONTINENTAL LOCATIONS SHOW A RAPID WARMING, THEN COOLING THROUGH THE YEAR, WHILE SF STAYS VERY SIMILAR THROUGHOUT.

8. Why is Denver always slightly cooler than Springfield?

DENVER'S ELEVATION IS MUCH HIGHER THAN SPRINGFIELD'S (MILE HIGH STADIUM) AND THIS DIFFERENCE KEEPS DENVER COOLER YEAR-ROUND.

9. Explain the factors that influence the San Francisco curve. (Note: next to San Francisco there is a cold ocean current, especially in summer.)

THE COLD OCEAN CURRENT (THE CALIFORNIA CURRENT) BRINGS COLD ARCTIC WATER INTO THE AREA DAMPENING THE EFFECT SUMMER INSOLATION BRINGS AND KEEPS TEMPS LOWER. ALSO FOG IN SUMMER BLOCKS INSOLATION.

10. For each of the three cities, determine the month in which the maximum temperature occurs. Explain why the maximum occurs at this time in each case.

DENVER + SPRINGFIELD - JUNE: THIS IS THE LAG EXPECTED IN TIME FROM MAX INSOLATION UNTIL MAX TEMPS.

SAN FRANCISCO - SEPT: THE COLD WATER AND FOG PREVENT NORMAL SUMMER WARMING AND IT IS SEPTEMBER BEFORE THESE EFFECTS LESSEN... RESULTING IN A MORE NORMAL FALL (BUT THIS RESULTS IN BEING A HIGH TEMP).

CONVERT °F TO °C			
25°F	=	-3.89°C	
92°F	=	33.33°C	
CONVERT °C TO °F			
15°C	=	59°F	
50°C	=	122°F	
CONVERT °F TO °K			
45°F	=	280.22°K	

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