Altitude (km)	Latitude		
	70N	30N	0
6	13.0	6.2	3.4
7	10.5	6.1	4.0
8	9.6	5.3	2.8
9	8.7	4.9	2.0
10	7.4	4.9	2.0
11	6.3	3.9	2.1
12	5.3	3.3	1.8
13	4.6	2.6	1.8
14	4.0	2.3	1.8
15	3.5	2.2	1.8
16	3.0	2.2	1.6
17	2.4	2.4	1.7
18	1.8	2.7	2.1
19	1.2	2.7	2.8
20	0.8	2.2	3.2
21	0.5	1.6	3.1
22	0.4	0.9	2.7
23	0.3	0.6	2.2
24	0.2	0.4	1.7
25	0.2	0.3	1.5

The SAGE-II experiment was flown on the International Space Station beginning October 5, 1984 and ended its investigations on August 26, 2005. The SAGE-III instrument will be launched in 2014 and complete programs begun by the SAGE-I and SAGE-II instruments.

Aerosols can block out sunlight reaching the ground, which is a process called extinction. This can causes changes in the heating of Earth and can alter its climate.

The SAGE instruments produce data tables like the one shown to the left. The table gives the altitude of the measurement. The columns give the extinction measured at different latitudes indicated in the top row. The numbers indicate the aerosol extinction in units of 0.0001 km^{-1}. For example, at 6 kilometers altitude at a latitude of 30N, the extinction was 6.2 x 0.0001 = 0.00062 km^{-1}.

Problem 1 – At what location is the extinction A) the highest? B) the lowest?

Problem 2 – Above an altitude of 20 kilometers, what is the average extinction at each latitude?

Problem 3 – Graph the extinction data for 30N between an altitude of 6 and 14 km and draw a straight line through the data. What is the slope of this line, and what are the units for this slope?

Problem 4 – Write the equation of the line that you drew in Problem 3, and use it to estimate the extinction at an altitude of 19 kilometers. Is our mathematical model a good fit to the actual data?

The SAGE-II Lesson Plan for graphing data can be found at
http://science-edu.larc.nasa.gov/EDDOCS/Aerosols/aer_sci.html

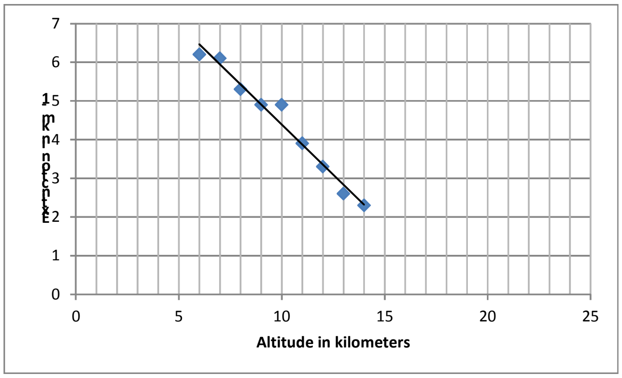
Problem 1 – At what location is the extinction A) the highest? B) the lowest?

Answer: A) **At 70N at an altitude of 6 km** above the ground where its value is 13.0 x 0.0001 = **0.0013** km^{-1}. B) **At an altitude of 24-25 km for 70N** where its value is 0.2 x 0.0001 = **0.00002** km^{-1}.

Problem 2 – Above an altitude of 20 kilometers, what is the average extinction at each latitude?

Answer: 70N: (0.8+0.5+0.4+0.3+0.2+0.2)/6 = 0.4 or 0.4 x 0.0001 = **0.00004** km^{-1}.
30N: (2.2+1.6+0.9+0.6+0.4+0.3)/6 = 1.0 or **0.0001** km^{-1}.
0 N: (3.2+3.1+2.7+2.2+1.7+1.5)/6 = 2.4 or 2.4 x 0.0001 = **0.00024** km^{-1}.

Problem 3 – Graph the extinction data for 30N between an altitude of 6 and 14 km and draw a straight line through the data. What is the slope of this line, and what are the units for this slope? Answer: See graph below. The slope is -0.52 and the units will be $(km^{-1})/km = km^{-2}$ or $1/km^2$



Alternate slope method using two-point formula and data table:
M = (y2-y1)/(x2-x1) so for the points at 6km and 14 km, M = (2.3-6.2)/(14 – 6) = -0.49 km^{-2}.

Students estimates should be close to M = -0.5 km^{-2}

Problem 4 – Write the equation of the line that you drew in Problem 3, and use it to estimate the extinction at an altitude of 19 kilometers. Is our mathematical model a good fit to the actual data?

Answer: The y-intercept for x=0 km is about +9.5, then **y = -0.5X + 9.5**. At an altitude of 19 km, the extinction would be y = -0.5(19)+9.5 = **0.0** km^{-1}. The data show that the extinction is 0.00027 km^{-1} at this altitude, so we should not try to predict extinctions for altitudes outside the domain of our linear fit (6 to 14 km).