**Teacher Help**

Aerosols and Environment Day 1

* Slide 9 Exercise Answers:
  + Rush hour because more cars on the road will emit more aerosols, increasing the concentrations in the area.
  + Windy. Wind will disperse the aerosols, so they don’t just sit over an area.
* Slide 10 Exercise answers:
  + Current concentration = 1 gram per 10 liters = 1/10 = **0.1 g/L**
    1. To decrease concentration to 0.05 g/L, we need to double the amount of water. We can do this by seeing 1 g divided by 0.05 g/L = **20 L**
* To increase concentration to 3 g/L, we need to manipulate the amount of salt. So, we can multiply 10 L by 3 g/L to get units to cancel out and find that we need **30 grams of salt** to do this.
* **If they have learned about dimensional analysis, this is a good and practical use of it**
* Slide 11 notes:
  + This map displays the January 2011 monthly average PM2.5 surface concentration.
  + Notice that each of these high concentration areas are cities. The anthropogenic sources like fossil fuel burning are common and critical in the cities. This is where pollution produced by us. As there are many cars and human activity in the cities. Hence, the cities and high populated areas have more PM2.5 surface concentration.
  + We are now going to do guess the cities and notice how the concentrations are drastically higher in those regions.
  + The first one is Atlanta, Georgia
* Slide 12 notes:
  + Washington D.C.
* Slide 13 notes:
  + New York City, New York
* Slide 14 notes:
  + Seattle, Washington
* Slide 15 notes:
  + Sacramento, California
  + Overall, Notice that in the northeast region where there are a lot cities that intersect and create megacities have more concentrations than everywhere else
* Slide 16 notes:
  + This map displays the PM2.5 surface concentration around the time that the forest fires occurred in California in September 2020.
  + These concentrations include the anthropogenic sources of cars and human activity. However, these maps clearly display the impact of forest fires(which is one of the natural sources) on the PM2.5 concentrations. As the concentrations have drastically increased in a couple of weeks due to the forest fires impact.

Aerosols and Environment Day 2

* Slide 22 extra notes:
  + In the Six Cities Study, the individuals who were monitored were between the ages of 25 and 75, primarily white. They were asked questions regarding their age, sex, weight, height, education level, complete smoking history, occupational exposures, and medical history. Data control was used to account for the varying ages and other health concerns, so everyone is on the same statistical playing field. **In the study results, there was no difference between one individual and the next.** The air pollution that was analyzed was PM 2.5, PM 10, and PM 15, with a focus on PM 2.5 as suspended particulate matter, sulfur dioxide, ozone, and suspended sulfates. The leading causes of death were heart disease, chronic pulmonary disease, and lung cancer.
  + A full write up of the study can be found here: <https://www.nejm.org/doi/full/10.1056/nejm199312093292401>
* Slide 24 notes:
  + The reason the pollution in these cities is so high is because the countries have high populations, yet their economies lag behind most developed countries. In an effort to catch up, there are little to no regulations on emissions from industry and power plants. Combine this with high emissions from transportation due to crowded urban areas and unfavorable climates for pollution dispersion, and you get massive smog clouds that hang over these cities for weeks at a time.
* Slide 26 notes:
  + Each letter corresponds to a city where the experiment was done.
    1. P = Portage, Wisconsin; T = Topeka, Kansas; W = Watertown, Massachusetts; L = St. Louis, Missouri; H = Harriman, Tennessee; S = Steubenville, Ohio. Period 1 = 1974–1989; Period 2 = 1990–1998.
  + The graph shows that increased PM concentrations in the atmosphere are associated with an increased mortality.
* Slide 27 notes:
  + These equations were determined through many experiments to depict the relationship between the concentration and mortality rate.
* Slide 28 Exercise Answers:
  + When addressing social costs, the EPA has set the standards for PM2.5 concentrations to be less than or equal to 12 μg/m3. The first problem determines the social cost by applying the 12 μg/m3.
  + AF = 1-e(-0.0052 (m^3/μg) x 12 (μg/m^3)) => AF = 0.0605
    1. MPM2.5 = AF x Mtotal = 0.0605 x 2,500,000 deaths/year => **MPM2.5 = 151,250 deaths/year**
    2. % PM2.5 = (MPM2.5 / Mtotal ) x 100 = (151,250 deaths/year)/(2,500,000 deaths/year) x 100 = **6.05% PM2.5**
    3. Notice that the percentage of people who die due to PM2.5 is equal to Attributable Fraction as a percentage (AF times 100).
  + Follow the same method as above for part a
    1. Sample: if PM2.5 has 12 (μg/m^3) -> AF = 0.06049 and Mtotal = 135,000 deaths/year -> MPM2.5 = 8167 deaths/year in Georgia due to PM2.5
  + You can compare the social costs in a rural area in georgia to atlanta
* Slide 30 notes:
  + These links provide some activities for k-8 and some teacher’s guide for the concepts of aerosols