

# Visible and Invisible Pollutants Answer Key

1. Which particulate pollutant would cause the most harm to people?  
**2  $\mu\text{m}$  particle**
2. Explain your answer.  
**The 2  $\mu\text{m}$  particle is the smallest particle. That means it can go the deepest into the body. If it can go deeper into the body, it can cause more health problems.**
3. How certain are you about your claim based on your explanation?  
**Student answers will vary.**
4. Explain what influenced your certainty rating.  
**Student answers will vary. Scientific evidence includes: smaller particles are not filtered out by the nose and the 2  $\mu\text{m}$  particle is the smallest particle.**
5. Which areas had the highest concentration of PM<sub>2.5</sub> pollutants?  
**Northern Africa, India, and China had the highest concentration of PM<sub>2.5</sub> pollutants.**
6. Why did these areas have higher concentrations of PM<sub>2.5</sub> pollutants? Hint: What is the likely origin of the pollutants in Northern Africa vs. Asia? (Think about the geography of the areas.)  
**The likely origin of the African particles is sand since the area with high concentrations overlaps the Sahara Desert. The likely origin of the Asian particles is vehicle, power plant, or other burning emissions. This area is highly populated, and people use vehicles or burn materials.**
7. If the human emission rate of PM<sub>2.5</sub> pollutants continues at the same rate as 2013, what might this map look like in 10 years and in 100 years? Why?  
**If the human emission rate of PM<sub>2.5</sub> pollutants continues at the same rate, I would expect this map to show largely the same thing. If there are more humans, there might be slightly more particulate matter emitted. But since particulates are regularly removed from the air by precipitation, the emissions wouldn't change by that much, overall.**
8. What effect do aerosols have on the amount of solar radiation that hits Earth's surface?  
**Aerosols decrease the amount of solar radiation reaching the surface.**
9. Explain your answer.  
**The diagram shows that aerosols limit the amount of sunlight entering the lower atmosphere. The incoming arrow is very large, but after the aerosol layer, there are only smaller arrows. This indicates that the amount of sunlight reaching the lower atmosphere is diminished by aerosols.**
10. Based on the data in the graph, which region likely had the worst air quality in 1975?  
**Europe**

# Visible and Invisible Pollutants

## Answer Key, continued

11. What was the most likely cause of the poor air quality?

burning coal

12. Explain your answer.

The graph shows that Europe had the highest level of SO<sub>2</sub> emissions in 1975. This means that it likely had the worst air quality (based on this limited information) because SO<sub>2</sub> is a pollutant. The likely cause of the poor air quality is burning coal. This is because most of the sulfur dioxide emissions in 2008 was from fuel combustion. Coal is a fuel, and it is burned. Forest fires are only 0.08% of the 2008 emissions, and factory production (which may be industrial processes) is only 8.73% of the 2008 emissions.

13. How certain are you about your claims based on your explanation?

Student answers will vary.

14. Explain what influenced your certainty rating.

Student answers will vary. Scientific evidence includes: specific reference to the graph and to the pie chart. Students may state that the pie chart shows percentages of emissions from 2008 and not 1975 as well as being specific to emissions from the United States.

15. What was likely happening in Europe between 1990 and 2000?

fewer cars being driven

16. Explain your answer.

According to the graph, the level of anthropogenic (human-caused) NO<sub>x</sub> emissions dropped between 1990 and 2000. According to the pie chart, NO<sub>x</sub> emissions from mobile sources (like cars) are the biggest percentage of human NO<sub>x</sub> emissions. If fewer cars were driven, the NO<sub>x</sub> emissions would be expected to decline. Fewer forest fires would also lead to a decline, but since fires only make up 0.21% of all emissions, that wouldn't show up so much on the graph. Fewer pollution controls would lead to greater pollution, not less as seen on the graph. More industrial production would also probably lead to higher emissions of NO<sub>x</sub>, which doesn't match the decline in NO<sub>x</sub> emissions on the graph.

17. How can indoor air quality often be worse than outdoor air quality?

Indoor air quality can often be worse than outdoor air quality because the wind cannot move pollutants away, and precipitation cannot remove pollutants from the air. Additionally, there are many things indoors, such as carpeting and furniture that can release VOCs, a type of air pollutant. The pollutants are trapped in the building, even more so in energy-efficient buildings in which there are few air leaks around doors and windows.

# Visible and Invisible Pollutants

## Answer Key, continued

18. Where is carbon monoxide more dangerous to human health?

indoors

19. Explain your answer.

Carbon monoxide is more dangerous indoors than outdoors because the CO can be diluted in the outdoor air. There is more space for the CO to move. Indoors, the CO is trapped and can build up to levels that can cause serious harm or death to the building's occupants.

20. Which line on the graph shows the pollution level over Burnside City during and after the forest fire?

Line C

21. Explain your choice.

The number of pollutants would increase during the fire. The level would be highest when the fire is burning the most intensely, and the level of pollutants would drop off only after the fire was put out as pollutants would still be blowing around in the wind. Line A shows that the pollutant level drops. The pollution level would drop when the fire got put out. Line B shows that the level of pollutants goes up only a little and mostly after the fire. This might be the answer if the wind was blowing most of the pollutants away from Burnside City. Line D shows the pollution level peaking after the fire. As earlier stated, the level of pollutants would be highest during the fire, not after the fire.