5. Other related information:

- Average global temperatures are rising: the 20th century was the warmest the world has seen in 1000 years, and the 1980s and 1990s were the warmest decades on record. A northern country, Canada will feel the impacts of climate change more than most countries.

4.16 AIR QUALITY SOLUTIONS—YOUR ROLE

TRY THIS ACTIVITY: INTERPRETING THE AIR QUALITY INDEX

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Table 1 Sample Weekly AQI Data

Pollutant	Mon. conc. (ppb)	Index level	Tues. conc. (ppb)	Index level	Wed. conc. (ppb)	Index level	Thur. conc. (ppb)	Index level	Fri. conc. (ppb)	Index level
SO_2	153	24	612	81	288	47	351	56	428	63
O_3	52	33	85	53	32	20	60	39	76	50
NO_2	233	38	771	108	460	70	588	85	697	99
TRS*	17	28	56	76	33	53	24	40	46	66
CO	63	20	428	89	216	59	412	87	366	80
SP^+	12	19	65	79	32	52	40	58	62	77

* Total Reduced Sulfur

+ Suspended Particles

Table 2 Summary of AQI Results

Day	AQI	Pollutant with highest number
Monday	38	NO_2
Tuesday	108	NO_2
Wednesday	70	NO_2
Thursday	87	CO
Friday	99	NO_2

SECTION 4.16 QUESTIONS

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Understanding Concepts

1. (a) Primary pollutants are formed from natural and industrial processes, such as burning fossil fuels. Primary air pollutants include carbon dioxide, $CO_{2(g)}$, carbon monoxide, $CO_{(g)}$, sulfur dioxide, $SO_{2(g)}$, methane, $CH_{4(g)}$, nitrogen oxides, $NO_{x(g)}$, particulate matter (PM), and the vapours from volatile organic compounds (VOCs).
   (b) Secondary air pollutants include ground-level ozone and smog, and are formed during chemical reactions between primary pollutants and sunlight or components of air.

(c) Particulate matter includes all airborne particles resulting from smoke, construction sites, forest fires, road dust, and vehicle emissions. The two types of particulate matter are PM_{10} (particles that are <10 microns in diameter) and $PM_{2.5}$ (particles that are <2.5 microns).

2. Originally, smog was a term used to describe a mixture of smoke and fog. Smog refers to a mixture of air pollutants seen as a haze in the air. The two main ingredients in smog are ground-level ozone and fine particles. Smog also contains nitrogen dioxide, sulfur dioxide, carbon monoxide, and ammonia. Fine particles and the reddish-brown nitrogen dioxide give smog its colour.
3. (a) Photochemical smog is produced by the reaction between products of fossil fuel combustion in the presence of sunlight.
   (b) The three components of photochemical smog are sunlight, ground-level ozone, and fine particles. Smog also contains nitrogen dioxide, sulfur dioxide, carbon monoxide, and ammonia. Fine particles and the reddish-brown nitrogen dioxide give smog its colour.
4. (a) Ground-level ozone is the same molecule as stratospheric ozone: $O_{3(g)}$.
   (b) Ground-level ozone plays a different role than stratospheric ozone. Ground-level ozone damages vegetation and is harmful to human health by affecting the respiratory system and irritating eyes. Stratospheric ozone is beneficial because it blocks harmful UV radiation from reaching Earth's surface.
5. (a) The pollutants that are measured to determine air quality include sulfur dioxide, ozone, nitrogen dioxide, total reduced sulfur compounds (TRS), carbon monoxide, and suspended particles (SP).
   (b) The levels of these six air pollutants are measured because they are the most common pollutants and, at high levels, they have adverse effects on human health and on the environment.
6. (a) The Air Quality Index is determined from readings from different reporting stations around the province and the TAGA. Throughout the day and night, the concentration of each pollutant is converted into a number using a common scale, or index. The pollutant with the highest number at a given hour becomes the AQI reading for a particular reporting station. The lower the AQI, the better the air quality.
   (b) The consequences associated with each range of values for ozone in the Air Quality Index are shown in **Table 3**.

Table 3 Relationship between AQI Levels for Ozone and Consequences

AQI level for ozone	0–15	16–31	32–49	50–99	>100
Consequences	no harmful effects	some vegetation damage	some vegetation damage	odour and additional vegetation damage	harmful to people with asthma and bronchitis

Making Connections

7. Student answers may vary. A sample answer is shown in **Table 4**.

Table 4 Air Quality Index Values for London, Ontario, May 18–24, 2003

Date	AQI value	Reason	Pollutant concentration (ppb)
May 24	31	ozone	25–49
May 23	20	SP	10–19
May 22	30	ozone	25–49
May 21	30	ozone	25–49
May 20	20	SP	10–19
May 19	37	ozone	50–74
May 18	26	ozone	25–49

During the week of May 18–24, 2003, the most common determinant of the Air Quality Index in London, Ontario, was ozone, with an average AQI of 30.8. At this level of ozone, it is predicted that some vegetation damage will have occurred.

8. (a) Student answers will vary. Students could present the argument that a reduction in automobile use would have the most significant long-term improvement on air quality. Emissions from vehicles largely contribute to the formation of smog. Using alternative forms of transportation can drastically reduce the amount of air pollutants and improve the air quality.

(b) Student answers will vary. Students could present the argument that none of the suggestions are impractical and not likely to result in any improvement in air quality. All alternatives are reasonable in scope and expectations.

9. Student answers will vary depending on personal viewpoints. Students could answer that they believe that the proposed solutions to air quality problems will work if carefully implemented. The suggestions presented in this section are reasonable reductions in everyday activities. By simply making conscious decisions about the time of day to undertake an activity, the amount of air pollutants produced on a bad air day can be greatly reduced.

Extension

10. Student answers may vary. Student answers may include the following points in their discussions of how individuals can contribute to the improvement of air quality through their choice of transportation.
    - Follow refuelling instructions for efficient vapour recovery. Be careful not to spill fuel and always tighten the gas cap securely.
    - Refuel cars and trucks after dusk.
    - Keep car, boat, and other engines tuned up according to manufacturers' specifications.
    - Be sure your tires are properly inflated.
    - Carpool, use public transportation, bike, or walk whenever possible.
    - Choose a cleaner commute—share a ride to work or use public transportation. Bicycle or walk to errands when possible.
    - Defer use of gasoline-powered lawn and garden equipment.
    - Combine errands and reduce trips.
    - Limit engine idling.

4.17 THE TAGA

TECH CONNECT 4.17 QUESTIONS

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Understanding Concepts

1. The Trace Atmospheric Gas Analyzer (TAGA) can detect general concentration levels of airborne contaminants in the low parts per billion (ppb) range.
2. Possible uses for a mobile TAGA testing unit include:
    - random sampling of air quality in areas located away from a permanent testing facility
    - sampling air in specific locations to determine if air quality may be compromised
    - determining if air quality in a specific location may pose a health threat
    - investigating and identifying airborne contaminants of a known or unknown origin

Making Connections

3. The TAGAs that were used at Ground Zero in the aftermath of the 9/11 tragedy in New York were used to take samples of the air and dust, and to analyze the samples for the presence of pollutants that might pose a health risk to emergency workers. The samples were evaluated against standards and guidelines established to protect public health under various conditions.

    The TAGAs were used to measure levels of airborne contaminants, such as benzene, dichlorodifluoromethane, and trichlorofluoromethane.

UNIT 4 SUMMARY

MAKE A SUMMARY

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Student answers will vary. Answers should include a risk–benefit analysis of the action.

(a) Personal action: purchasing a hybrid vehicle