VOLUME 1

THINK ENVIRONMENT IN MATH

AIR

SOUTHWEST IN

HIDEKA YAMAGUCHI, PH.D.

PREFACE

The objective of this ***Think Environment in Math*** is to provide the quality education to young children in Southwest Indiana. This book is specifically designed for elementary students (grade 1-5) in this community.

Environmental problems have been a part of our human history since human activities started negatively affect the ecological balance of the earth thousands of years ago. Excessive human activities have induced local environmental destruction such as air pollution, water degradation, and resource depletion and have adversely impacted the local people and society.

Now with the emergence of global-scale ecological destruction, environmental problems are no longer just local problems. In this contemporary age, few societies are being left unaffected by global environmental problems. And all societies are now required to simultaneously provide concerted responses to those global environmental challenges as a part of global communities, while finding solutions for ongoing local environmental problems.

In such era when redesigning each community in which all needs are met in sustainable ways is a key to success of the community, provision of education on our environmental challenges becomes more critical than ever. Our community is no exception.

Currently, however, there are two fundamental problems when promoting environmental education through public/parochial elementary schools here in Southwest Indiana. First, due to time and curriculum constraints, local elementary schools are unable to allocate time and resources to teach environmental issues. Secondly, there is no educational material that provides accurate and collective information on the environmental challenges in our community.

To address these problems, the ***Think Environment in Math*** was created. While traditional educational materials on either environment and existing subject areas, including math, language arts, science, and history, have provided information on their focuses, this book attempted to marriage of those independently existing subject areas and integrated environmental subjects into core subjects. In this book, a focus was given to mathematics. By taking this new and unique approach, this book intends to improve students' knowledge on the local environmental issues while promoting their math skills and critical thinking skills.

Math skills targeted in this book are listed below.

Skills (Gr.1-5)

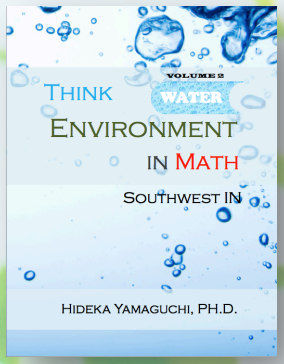
1. Addition / Subtraction
2. Rounding
3. Estimating
4. Ordinal numbers
5. Use <, >, =
6. Number comparison
7. Place value
8. Expanded notation
9. Percentage / Fraction /Decimal
10. Multiplication / Division
11. Data analysis (line, bar, circle graphs & tables)
12. Range, mean, mode & median
13. Three-dimensional objects
14. Measurement (temperature, length & weight)
15. Probability

Very importantly, this book focuses specifically on the development of young children in southwestern Indiana to make up for disadvantages of using traditional educational materials that generalize local environmental problems. This book centers on local environmental problems and local environmental protection efforts, as well as state and country-level of problems to help students understand the local environment in a wider context.

I firmly believe that the quality education is a powerful tool to influence individual behavior. I strongly hope that "Think Environment in Math" provides an opportunity to improve your students' critical thinking skills and abilities, increase their environmental awareness, lead to significant changes in their decisions and actions, invite positive bottom-up changes in this community, and help ensure an environmentally sound and economically prosperous future in Southwest Indiana, in the end.

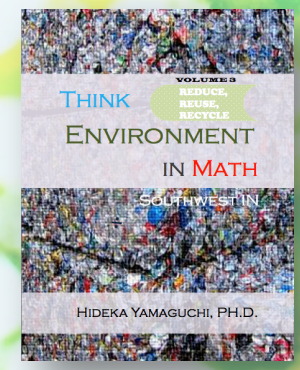
Hideka Yamaguchi, Ph.D.

Also available…



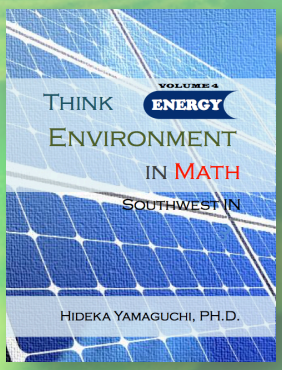
VOL. 2

WATER



VOL. 3

REDUCE
REUSE
RECYCLE



VOL. 4

ENERGY

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Overview Of problems

1 2 3 **4 5**

1. Our path to cleaner air

Subtraction (4 digits)

Suited grade level: In this case, this problem is suited for 4th and 5th grades

Title of the problem

Skills: Students use 4 digits subtraction to answer questions

Area level


global


national


state


county

1 2 3 **4 5**

1. Our path to cleaner air

Subtraction (4 digits)

1 **2 3** 4 5

2. What is the most polluted city?

Addition (1 digit)

Subtraction (1 digit)

Ordinal numbers (1 digit)

1 2 3 4 5

3. How many unhealthy days in our area?

Bar graphs (up to 20)

Subtraction (2 digits)

<, >, =

1 2 **3 4** 5

4. Got healthier air in Vanderburgh?

Bar graphs (up to 31)

Subtraction (2 digits)

<, >, =

1 2 **3 4 5**

5. Is our air getting cleaner?

Line graphs (5 digits)

Estimating (5 digits)

Subtraction (3 or 4 digits)

Rounding (3, 4 or 5 digits)

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1 2 3 4 5

6. What not to burn for healthier air

Three-dimensional objects

1 2 3 4 5

7. Who has the cleanest car?

Bar graphs (up to 50)

Subtraction (2 digits)

Half double

<, >, =

Multiplication division

1 2 3 4 5

8. What keeps Earth warm?

Temperature

1 2 3 4 5

9. Pika & climate change

Line graphs (up to 25)

Percentages fractions

1 2 3 4 5

10. How much does sea level rise?

Inch & foot

1 2 3 4 5

11. The hottest & coldest days

Line graphs (3 digits)

Subtraction (3 digits)

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1 2 3 4 5

12. What makes harmful gas?

Bar graphs (up to 10)

1 2 3 4 5

13. Who makes harmful gas?

Bar graphs (up to 11)

Circle graphs

Percentages fractions decimals

Multiplication division

1 2 3 4 5

14. How big is harmful gas?

Bar graphs (3 digits)

1 2 3 4 5

15. Do we make more harmful gas or less?

Line graphs (3 digits)

List of Problems by Contents

AIR

❖ Air Pollution

❖ Climate Change

#	Title	Area level	Grade	Skills	Page
7	Who has the cleanest car?	National	**Data Analysis**		51
			G2-5	Bar graphs (up to 50)	
			Number & Operations		
			G2	>, <, = symbols	
			G2-3	Subtraction (2 digits)	
			G3-4	Half and double the amount	
			G4-5	Multiplication and division	
8	What keeps Earth warm?	Global	**Measurement**		64
			G5	Temperature	
9	Pika & climate change	National	**Data Analysis**		68
			G5	Line graphs (up to 25)	
			Number & Operations		
			G5	Fractions & Percentages	
10	How much does sea level rise?	Global	**Measurement**		73
			G3-4	Inch & foot	
11	The hottest & coldest days	County	**Number & Operations**		77
			G3-4	Subtraction (3 digits)	
			Data Analysis		
			G4-5	Line graphs (3 digits)	
12	What makes harmful gas?	National	**Data Analysis**		84
			G2-4	Bar graphs (up to 10)	
13	Who makes harmful gas?	State	**Data Analysis**		88
			G2-3	Bar graphs (up to 11)	
			G3-4	Circle graphs	
			Number & Operations		
			G4-5	Percentage, decimal & fraction	
			G4-5	Multiplication and division	
14	How big is harmful gas?	State	**Data Analysis**		98
			G3-4	Bar graphs (3 digits)	
15	Do we make more harmful gas or less?	State	**Data Analysis**		105
			G3-5	Line graphs (3 digits)	

List of Problems by Math Skills

AIR

Number and Operations				
Addition & Subtraction				
	Problem #	Title	Grades	Page
1 digit	2	What is the most polluted city?	G2-3	11
Subtraction				
2 digits	3	How many unhealthy days in our area?	G2-3	20
	4	Got healthier air in Vanderburgh?	G2-4	28
	7	Who has the cleanest car?	G2-3	51
3 digits	5	Is our air getting cleaner?	G3	34
	11	The hottest & coldest days	G3-4	77
4 digits	1	Our path to cleaner air	G4-5	7
5 digits	5	Is our air getting cleaner?	G5	34
Rounding				
Whole numbers	5	Is our air getting cleaner?	G3-5	34
Estimating				
5 digits	5	Is our air getting cleaner?	G5	34
Ordinal numbers				
1 digit	2	What is the most polluted city?	G2-3	11
>, <, = symbols				
whole numbers	3	How many unhealthy days in our area?	G1-3	20
	4	Got healthier air in Vanderburgh?	G2-4	28
	7	Who has the cleanest car?	G2	51

Percentages, fractions & decimals				
	8	Pika & climate change	G5	68
	13	Who makes harmful gas?	G4-5	88

Multiplication & Division				
Half, double the amount	7	Who has the cleanest car?	G3-4	51
Multiplication division	7	Who has the cleanest car?	G4-5	51
	13	Who makes harmful gas?	G4-5	88

Data Analysis

Line graphs

	Problem #	Title	Grades	Page
Up to 25	9	Pika & climate change	G5	68
3 digits	11	The hottest & coldest days	G4-5	77
3 digits	5	Is our air getting cleaner?	G5	34
5 digits	15	Do we make more harmful gas or less?	G3-5	105

Bar graphs

Up to 10	12	What makes harmful gas?	G2-4	84
up to 11	13	Who makes harmful gas?	G2-3	88
Up to 20	3	How many unhealthy days in our area?	G2-3	20
Up to 31	4	Got healthier air in Vanderburgh?	G2-4	28
Up to 50	7	Who has the cleanest car?	G2-5	51
3 digits	14	How big is harmful gas?	G3-4	98

Circle graphs

	13	Who makes harmful gas?	G3-4	88

Measurement

Temperature

	Problem #	Title	Grades	Page
	7	What keeps Earth warm?	G5	51

Length

Inch & Foot	10	How much does sea level rise?	G3-4	73

Geometry

Three-dimensional objects

	Problem #	Title	Grades	Page
	6	What not to burn for healthier air	G3-4	45

AIR

air pollution + climate change

It is estimated that the average person breathes 3,000 gallons of air each day. That means if the air in your area is polluted by dangerous chemicals, you inhale those contaminants into your lungs which could cause health problems. Air pollution is the introduction into the atmosphere of chemicals, particulates, and biological matter that can have adverse effects on human health and/or other living organisms, or damage the natural environment. In this country, more than 4 out of 10 people still live in regions where the concentration of certain air pollutants exceeds federal standards. In addition, increasing concentration of greenhouse gases in the atmosphere over the past century has led to climate change (see pages 62-63) that may result in more severe weather events, including intense rains, floods, droughts, snow, and extreme heat and heat waves in many regions.

air pollution

Sources of Air Pollution

There are two major categories in terms of sources of air pollution: anthropogenic sources (man-made sources) and biogenic sources (natural sources). Man-made air pollution is mostly related to burning fossil fuels (coal, petroleum, and natural gas). In particular, the transportation sector has been the largest single source of air pollution in the United States.

Also, high levels of air pollutants such as sulfur oxides, nitrogen oxides, carbon monoxide, and carbon dioxide have been discharged from power plants, manufacturing facilities, and waste incinerators in the process of burning coal and petroleum. The air pollutants emitted from those sources have negatively affected human health and damaged the environment. Not only humans but the earth itself sometimes contributes to air pollution through volcanic eruptions, wildfires, wind erosion, pollen dispersal, evaporation of organic compounds, and natural radioactivity.

6 Common Air Pollutants

Under the Clean Air Act, the Environmental Protection Agency (EPA) sets air quality standards on a national level, in particular, on the emission of six air pollutants—ozone (ground level), particulate matter (PM), carbon monoxide (CO), nitrogen oxide (NOx)*, sulfur dioxide (SO_2), and lead. Those six air pollutants are recognized as six common air pollutants because they are commonly found across the nation and also known as six criteria air pollutants that need to be addressed to protect health of people and the environment in this country.

**EPA uses NO_2 as the indicator for the larger group of NOx.*

OZONE (ground level)

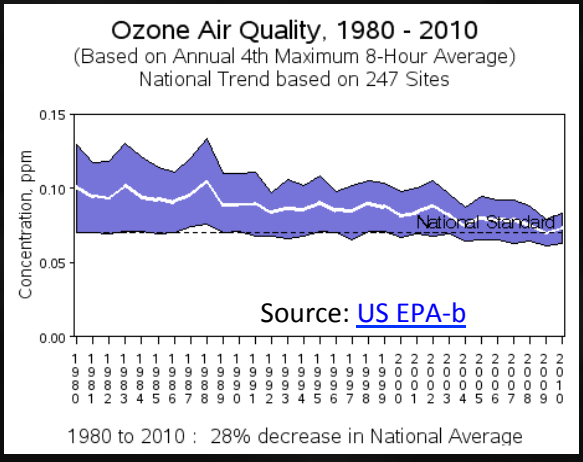
Ozone is found at both ground and upper levels of the atmosphere. While ozone in the upper atmosphere protects our earth from the sun's harmful ultraviolet (UV) radiation, a high concentration of ozone at ground level ends up becoming the main component of smog and haze.

causes

Emissions from industrial and power plants, motor vehicles, gasoline vapors, and chemical solvents are the main ingredients of ground level ozone.

adverse health effects

Exposure to higher levels of ozone can cause lung and throat irritation, shortness of breath, increase frequency of asthma attacks and aggravate respiratory conditions like emphysema and bronchitis.



Ground-level ozone has gradually declined, by 28%, since 1980 in the United States.

PARTICULATE MATTER

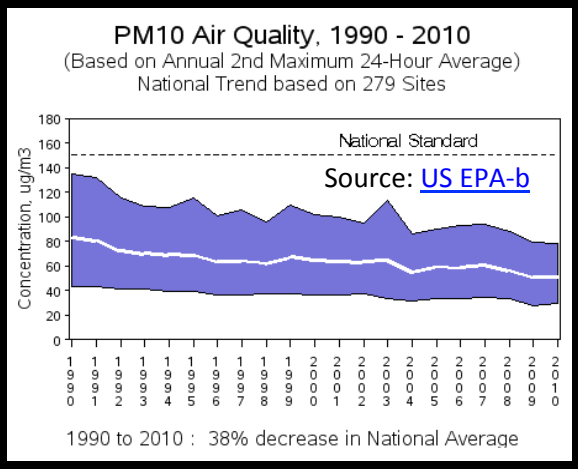
PM is a complex mixture of extremely small particles and liquid droplets found in the air. There are two types: PM_{10} and $PM_{2.5}$. PM_{10} includes inhalable coarse particles (dust, dirt, soot, or smoke with diameters 10-2.5 micrometers) and $PM_{2.5}$ includes fine particle with diameters smaller than 2.5 micrometers.

causes

Some particulates are emitted directly from sources, including construction sites, unpaved roads, fields, smokestacks or fires. Others come from industrial and power plants and motor vehicles.

adverse health effects

PM can cause a variety of health problems, including, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, increased respiratory distress, and premature death.



Levels of $PM_{2.5}$ reduced by 27% during 2000 and 2010 and those of PM_{10} decreased 38% since 1990.

CARBON MONOXIDE

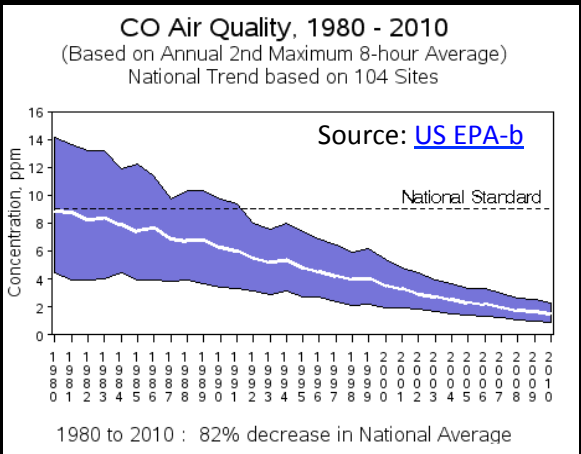
Carbon monoxide (CO) is a colorless, odorless gas emitted from burning processes.

causes

Most CO emissions come from mobile sources such as motor vehicles.

adverse health effects

CO reduces oxygen delivery to the body's organs and tissues and, at extremely high levels, can cause death.



Average CO concentrations have dramatically decreased since 1980.

NITROGEN OXIDE

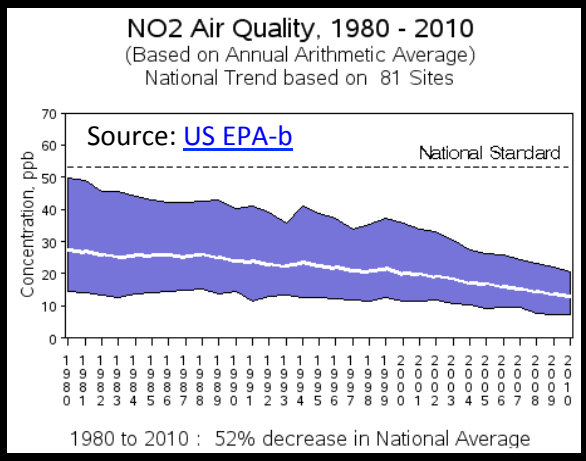
Nitrogen dioxide (NO_2) is one of a group of highly reactive gases known as NOx. NO_2 is a reddish-brown toxic gas and has a sharp biting odor.

causes

NO_2 can be created from emissions from motor vehicles, power plants, and off-road equipment.

adverse health effects

NO_2 can cause airway inflammation in healthy people and increase respiratory symptoms in people with asthma.



Levels of NO_2 reduced by 52% since 1990.

SULFUR DIOXIDE

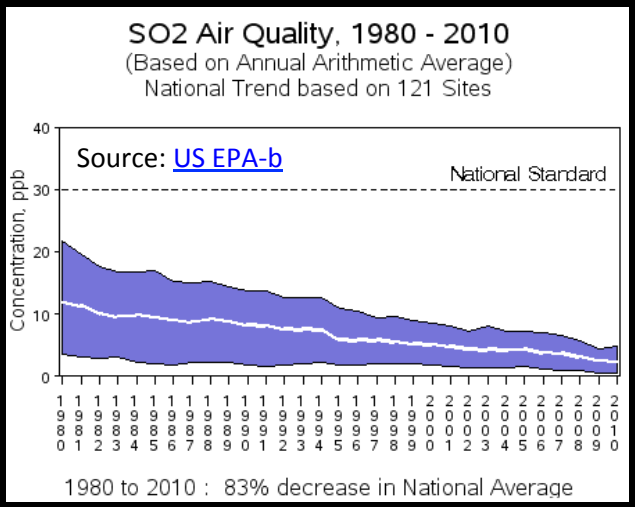
SO_2 is a toxic gas with an irritating smell.

causes

Most SO_2 emissions come from fossil fuel combustion at power plants (73%) and other industrial plants (20%).

adverse health effects

Exposure to SO_2 is linked to bronchoconstriction and increased asthma symptoms.



Levels of SO_2 dropped 83% during the 30 years since 1980.

LEAD

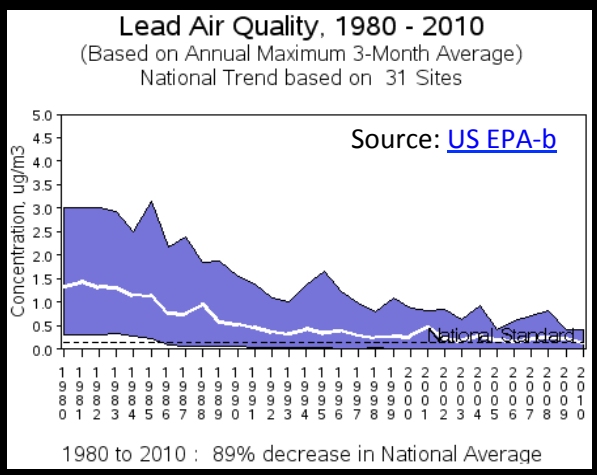
Lead is a heavy metal found naturally in the environment as well as in manufactured products.

causes

Sources of lead emissions in the air include ore and metals processing, waste incinerators, power plants, and motor vehicles.

adverse health effects

Lead can adversely affect the nervous system, kidney function, reproductive and developmental systems, immune system, and cardiovascular system.



Lead air quality has significantly improved.

Think Environment in Math

Who Protects our Air in Evansville?

Evansville Environmental Protection Agency


Vine Street, early 1900s
(photo courtesy of Evansville EPA)

In the early 1900s, our air in Evansville has been heavily polluted mainly due to the combustion of coal for energy generation, industrial production, and manufacturing.

The regulation of air pollution started in 1931, when the concern with air quality was first documented by Evansville's first smoke ordinance. Monitoring and controlling air pollutants in Evansville started in 1970 when the Air Pollution Control Department was created in the City of Evansville. In 1974, its role was taken over by the newly created Evansville Environmental Protection Agency (EEPA).

Open Burning Regulations

EEPA also regulates *open burning** since air pollution from open burning can cause serious health problems and damage the environment. Most open fires require advanced approval from the EEPA.

Evansville Environmental Protection Agency's website can be accessed at:
http://www.evansville.in.gov/index.aspx?page=52

Air Permits

Specifically, the EEPA regulates emissions of air pollutants by requiring businesses and manufacturers to obtain operating permits when they install, modify, or operate any equipment that could potentially discharge air pollutants.

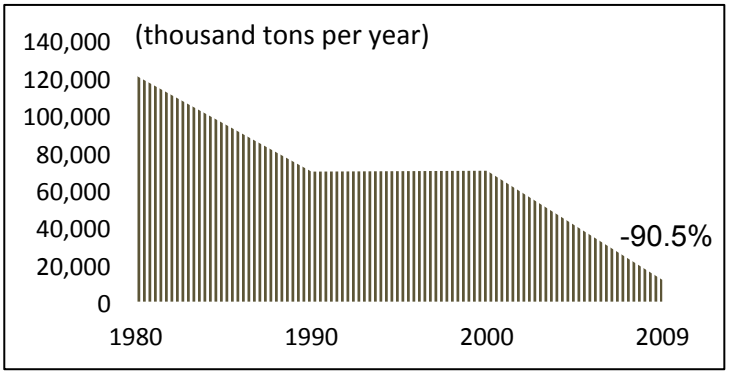
Ozone Alerts

In addition, the EEPA issues Air Quality Alerts including Ozone Alerts and Particulate Alerts when levels of some air pollutants are projected to exceed national air quality standards. Air Quality Forecasts are also provided on the EEPA's website.

**Open Burning* refers to the burning of any materials where the resulting air contaminants are emitted directly into the air, without first passing through a stack or chimney from an enclosed chamber.

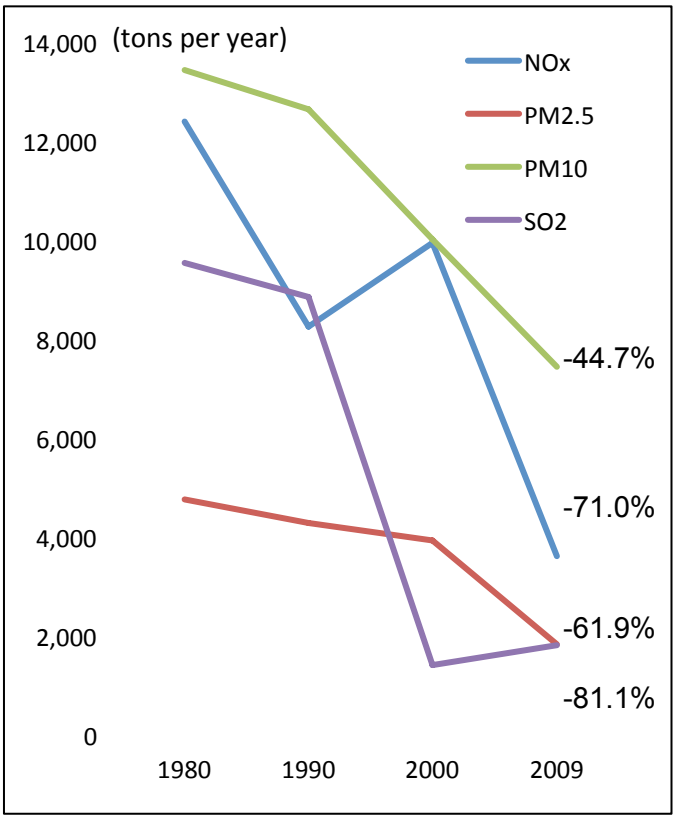
Thanks to a variety of clean air programs put in place locally, regionally (i.e. the NOx SIP Call, CAIR, and state rules), and nationally (i.e. the Acid Rain Program, Tier II Emission Standards for Vehicles and Gasoline Sulfur Standards, Heavy-Duty Diesel Engine Program, and the Clean Air Nonroad Diesel Rule), air quality in Evansville has improved significantly (IDEM (Indiana Department of Environmental Management), 2012)

Figures 1 and 2 show trends of the some of the air pollutants in Vanderburgh County since 1980. As you can see, amounts of carbon monoxide, nitrogen oxides, particulate matter, and sulfur dioxide have markedly declined over the last 30 years.



(Above) Figure 1. Carbon monoxide trend since 1980 in Vanderburgh County

(Right) Figure 2. Trends of nitrogen oxides, particulate matter 2.5 and 10, and sulfur dioxide since 1980 in Vanderburgh County



Source:
Criteria Pollutants Air Quality Trend Analysis Report (1980-2010), IDEM

Other local efforts

VECTREN

Vectren owns a total of 1,000 Mega Watt (MW) coal-fired power plants to meet energy demands in Evansville. The company has recently invested more than $410 million to upgrade its emission control equipment to reduce air pollution. As a result, SO_2 and NOx emissions have declined 90% and 80%, respectively, since 1970. The new equipment also removes particulate matter at an average of 99% efficiency.

WNIN

WNIN partnered with the Evansville Metropolitan Planning Organization (MPO) to create and air a monthly TV series titled "Healthy Air: Healthy Communities" to educate citizens about air quality. Episodes have focused on our history of air pollution and efforts that our community are making in environmental issues. The program can be viewed at http://video.wnin.org/program/healthy-air-healthy-communities/.

PROBLEM 1

Number & Operations

G4
G5

Subtraction (4-digit numbers)

OUR PATH TO CLEANER AIR

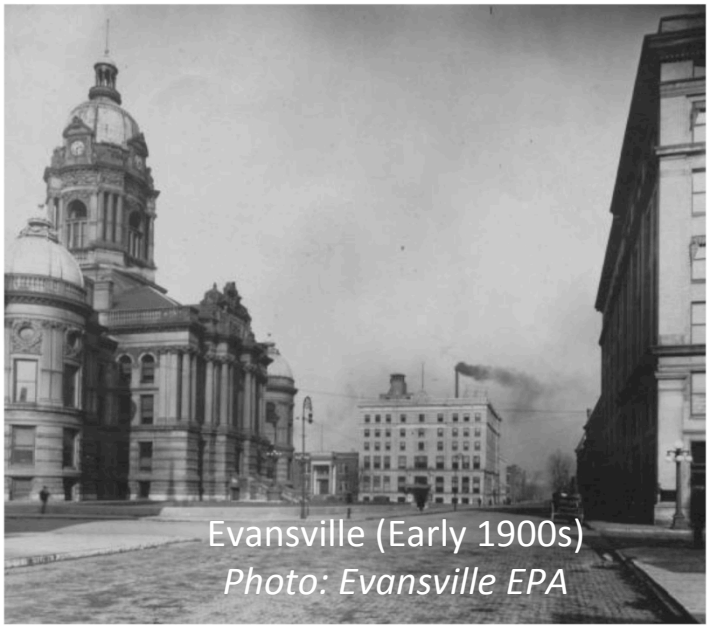
PURPOSE

Through this activity, **4th -5th grade** students will

- Subtract 4-digit numbers
- Improve timeline reading skills
- Understand efforts in air quality improvement in this country
- Develop awareness of air quality

BACKGROUND FOR THE TEACHER

During the mid 1900s, many cities in this country suffered from serious air pollution. For example, in 1948, thick clouds of air pollution that lingered for five days killed 20 people and made roughly 6,000 people sick in Donora, Pennsylvania. To control air pollution on a national level, the Clean Air Act was designed in 1963 as the first federal environmental law.



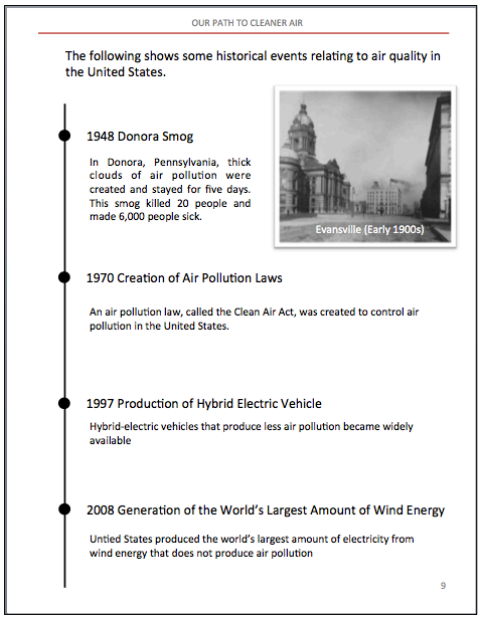
Evansville (Early 1900s)
Photo: Evansville EPA

In 1970, the Clean Air Act was dramatically revised to provide a more effective national program to address the nation's air quality. The United States Environmental Protection Agency (U.S. EPA), which was established in the same year, has taken a leading role in enforcing the law since then.

Under the Clean Air Act, the EPA sets standards on certain air pollutants regarding how much can be in the air and requires major industrial sources to install pollution control equipment to meet emissions standards. Monitoring systems that track emissions of certain pollutants also began in 1970 to record air quality trends. The EPA has also provided funding to promote clean air efforts.

TEACHER GUIDE

The timeline highlights some air quality-related events in the United States. Through computing the number of years between each event, students will strengthen skills on subtraction of large numbers, while enhancing understanding of our history of air quality improvement since the mid 1990s.

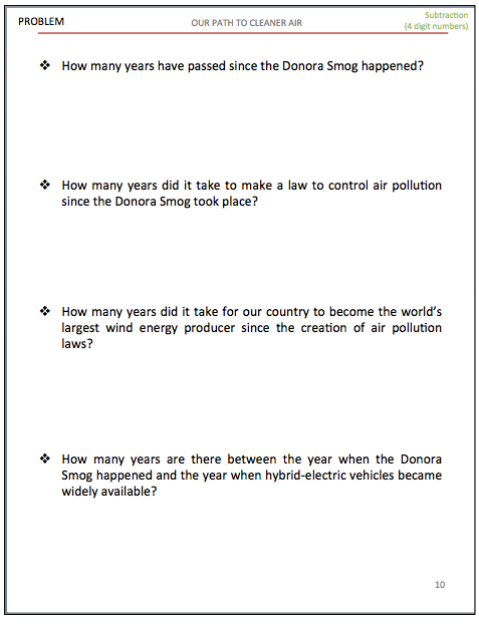


P 9—Student Sheet

PROBLEM

- *Subtraction (4-digit numbers)*

Using the numbers given in the timeline, students are asked to compute the number of years between two events.



P 10—Student Sheet

The following shows some historical events relating to air quality in the United States.

1948 Donora Smog

In Donora, Pennsylvania, thick clouds of air pollution were created and stayed for five days. This smog killed 20 people and made 6,000 people sick.

Evansville (Early 1900s)

1970 Creation of Air Pollution Laws

An air pollution law, called the Clean Air Act, was created to control air pollution in the United States.

1997 Production of Hybrid Electric Vehicle

Hybrid-electric vehicles that produce less air pollution became widely available

2008 Generation of the World's Largest Amount of Wind Energy

Untied States produced the world's largest amount of electricity from wind energy that does not produce air pollution

- How many years have passed since the Donora Smog happened?

- How many years did it take to make a law to control air pollution since the Donora Smog took place?

- How many years did it take for our country to become the world's largest wind energy producer since the creation of air pollution laws?

- How many years are there between the year when the Donora Smog happened and the year when hybrid-electric vehicles became widely available?

PROBLEM 2

Number & Operations

G2 G3	Addition & Subtraction (1-digit numbers)
G2 G3	Ordinal numbers (1-digit numbers)

WHAT IS THE MOST POLLUTED CITY?

PURPOSE

Through this activity, **2nd -3rd grade** students will

- Add one digit numbers (sums up to 10)—**PROBLEM A**
- Subtract one digit numbers—**PROBLEM A**
- Improve skills on ordinal numbers (1-digit numbers)—**PROBLEM B**
- Learn 10 cleanest-air cities and 10 most air-polluted cities in the United States
- Develop awareness of air quality

BACKGROUND FOR THE TEACHER

It has been reported that nearly 132 million people—42 percent of the nation—still live in regions where the concentration of certain air pollutants exceeds federal standards.

In our nation, California has long suffered from air pollution. Eight out of the 10 most air-polluted cities are located in California.

The largest factor that makes California dirty is transportation. About 60% of air pollutants come from mobile sources, such as cars, trucks, trains, ships, and aircraft. California has the largest number of motor vehicles registered in the United States, at 33 million.

	Actual values (Ranking in the U.S.)
Population	38 million (1)
Economy (Gross State Product)	$2.3 trillion (1)
Total CO_2 Emissions	270 million metric tons (2)
Electricity Generation	16 million MWh (4)
Number of Registered Vehicles	33 million (1)

California's ranking

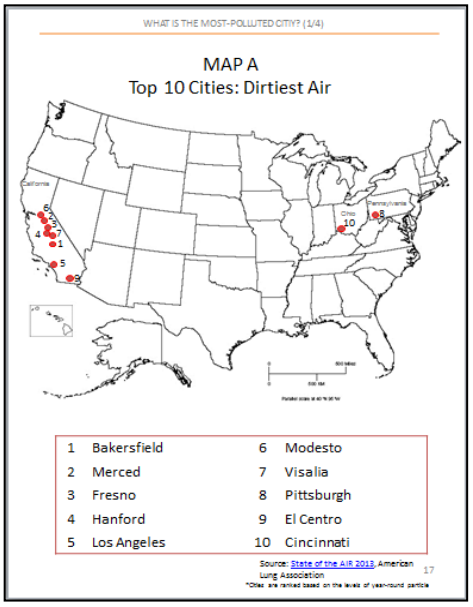
In addition, the ports of Los Angeles and Long Beach are also considered major contributors to air pollution. More than half of the goods shipped into the United States go through these two ports, and the goods are dispatched throughout the nation from there by using about 1,200 freight trains and 35,000 semi tractor-trailers every day. Exhaust from these mobile sources significantly deteriorates the air quality in California.

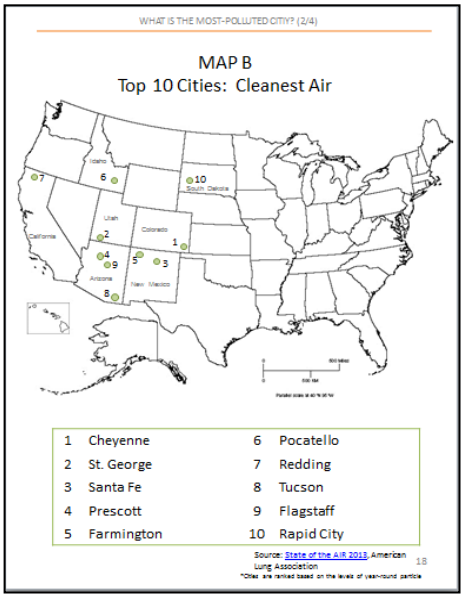
Moreover, an industrial corridor that stretches around these ports, and air pollutants discharged from here, the world's ninth-largest economy, makes the situation even worse.

TEACHER GUIDE

These two maps represent the 10 most air-polluted cities and the 10 cleanest-air cities in the United States. These maps are created based on data obtained from the American Lung Association.

MAP A: Top 10 Cities: Dirtiest Air (page 14)
MAP B: Top 10 Cities: Cleanest Air (page 15)

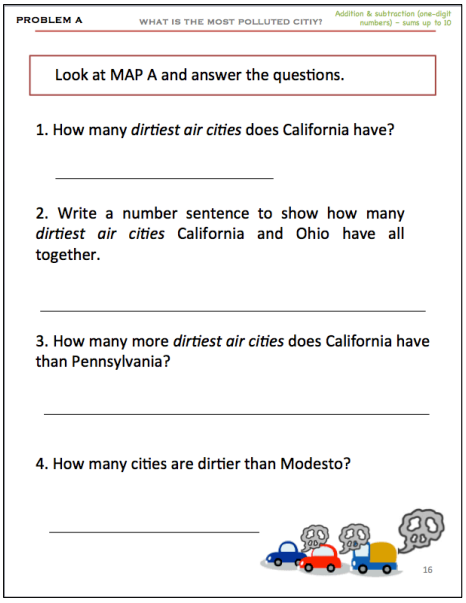




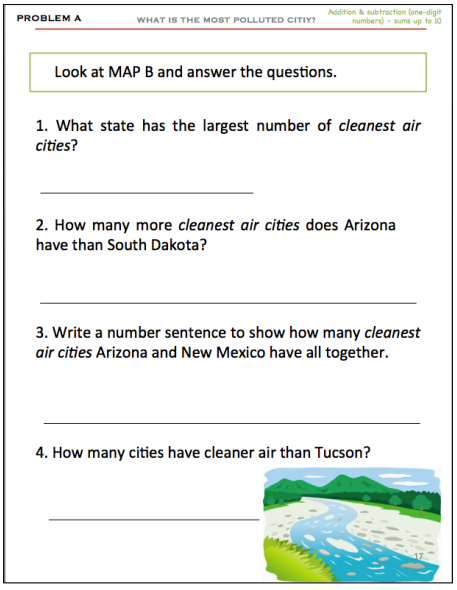
PROBLEM A

- *Addition (single-digit number)*
- *Subtraction (single-digit numbers)*

Using MAP A and MAP B, Students complete questions about the cities in the maps. Students will add and subtract single-digit numbers.



P 16—Student Sheet

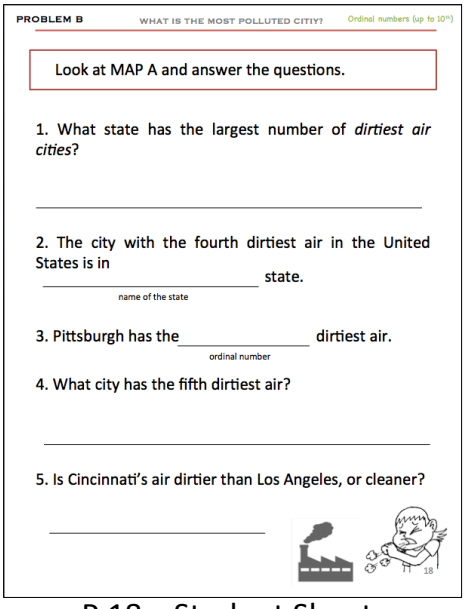


P 17—Student Sheet

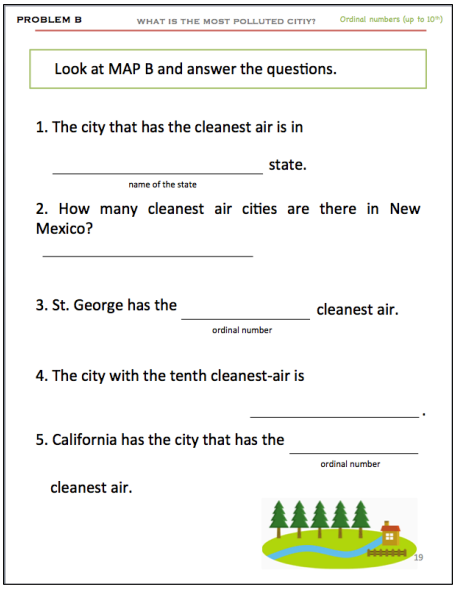
PROBLEM B

- *Ordinal numbers*

Using MAP A and MAP B, students complete questions about the cities on the maps. Students use ordinal numbers to answer questions.



P 18—Student Sheet



P 19—Student Sheet

MAP A
Top 10 Cities: Dirtiest Air

1	Bakersfield	6	Modesto
2	Merced	7	Visalia
3	Fresno	8	Pittsburgh
4	Hanford	9	El Centro
5	Los Angeles	10	Cincinnati

MAP B
Top 10 Cities: Cleanest Air

1	Cheyenne	6	Pocatello
2	St. George	7	Redding
3	Santa Fe	8	Tucson
4	Prescott	9	Flagstaff
5	Farmington	10	Rapid City

Look at MAP A and answer the questions.

1. How many *dirtiest air cities* does California have?

_____

2. Write a number sentence to show how many *dirtiest air cities* California and Ohio have all together.

_____

3. How many more *dirtiest air cities* does California have than Pennsylvania?

_____

4. How many cities are dirtier than Modesto?

_____

Look at MAP B and answer the questions.

1. What state has the largest number of *cleanest air cities*?

_____

2. How many more *cleanest air cities* does Arizona have than South Dakota?

_____

3. Write a number sentence to show how many *cleanest air cities* Arizona and New Mexico have all together.

_____

4. How many cities have cleaner air than Tucson?

_____

Look at MAP A and answer the questions.

1. What state has the largest number of *dirtiest air cities*?

_____

2. The city with the fourth dirtiest air in the United States is in _____ state.

name of the state

3. Pittsburgh has the _____ dirtiest air.

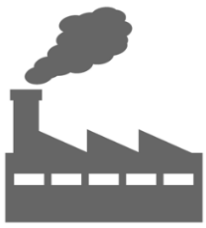
ordinal number

4. What city has the fifth dirtiest air?

_____

5. Is Cincinnati's air dirtier than Los Angeles, or cleaner?

_____



Look at MAP B and answer the questions.

1. The city that has the cleanest air is in

_____ state.

name of the state

2. How many cleanest air cities are there in New Mexico?

_____

3. St. George has the _____ cleanest air.

ordinal number

4. The city with the tenth cleanest-air is

_____ .

5. California has the city that has the _____

ordinal number

cleanest air.

PROBLEM 3

Data Analysis

G2 G3 Bar graphs (up to number 20)

G1 G2 G3 >, <, = symbols

Number & Operations

G2 G3 Subtraction (2-digit numbers)

HOW MANY UNHEALTY DAYS IN OUR AREA?

PURPOSE

Through this activity, **1st grade** students will

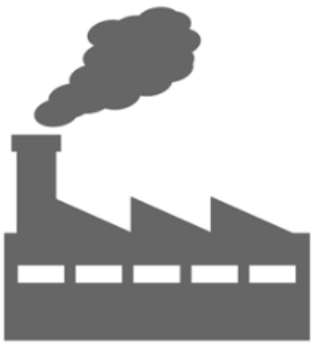
- Use the symbols <, >, and = to compare numbers—**PROBLEM A**
- Develop awareness of air quality

Through this activity, **2nd -3rd grade** students will

- Create bar graphs—**PROBLEM A & B**
- Use the symbols <, >, and = to compare numbers—**PROBLEM A**
- Subtract numbers (2-digit numbers) —**PROBLEM B**
- Develop awareness of air quality

BACKGROUND FOR THE TEACHER

Air pollution carries a significant risk to human health and the environment. Children are particularly vulnerable to the harmful effects of air pollution.

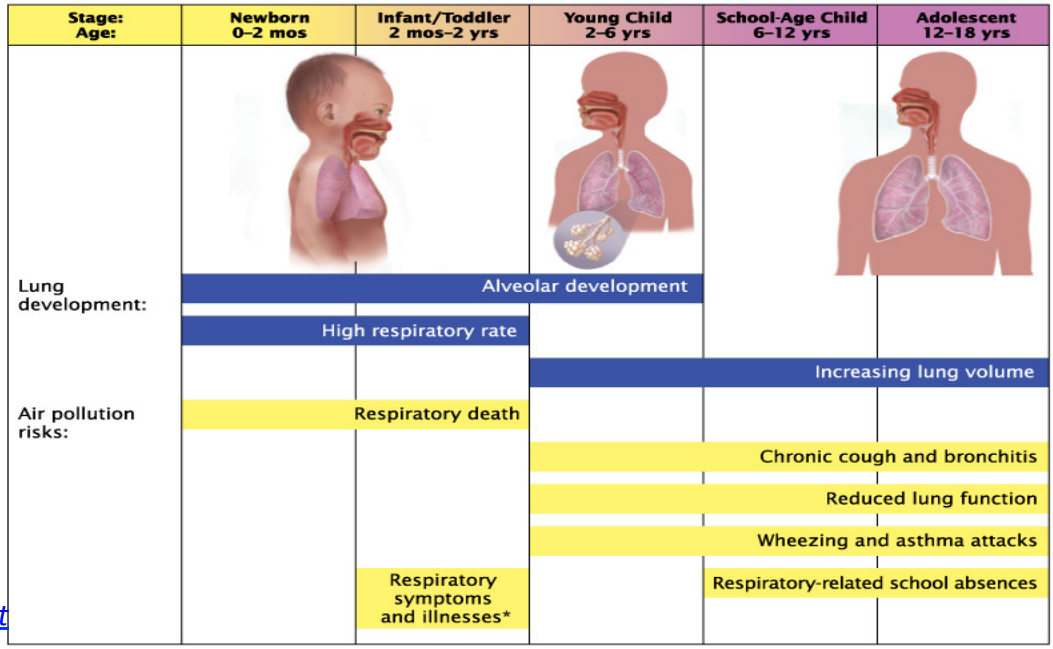


There are many sources that cause air pollution. Burning fossil fuels for electricity generation and transportation purposes is one of the major contributing factors to air pollution caused by human activity. (*more information on sources of air pollution on page 2*).

Health Effects

Air pollution is a significant contributor the development of respiratory infections, heart disease, asthma, pneumonia, and lung cancer. Epidemiological studies show that each year, more than 500,000 people are killed from cardiopulmonary disease linked to air pollution nationwide.

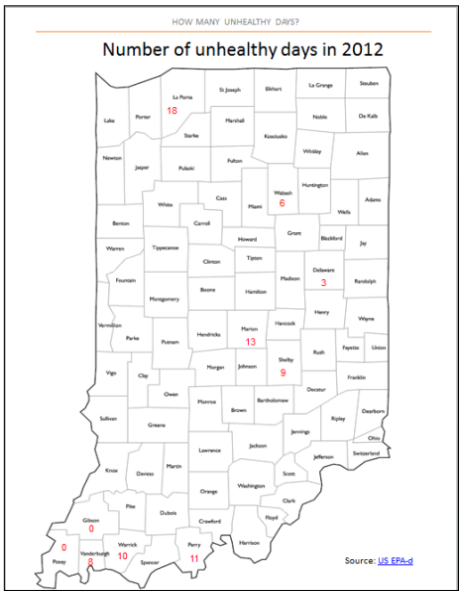
Children are considered to be more susceptible to the harmful effects of air pollution than adults since they spend more time outdoors and breathe 50% more air per pound of body weight than adults. Adverse health conditions include chronic cough and bronchitis, reduced lung function, wheezing and asthma attacks, and respiratory death.



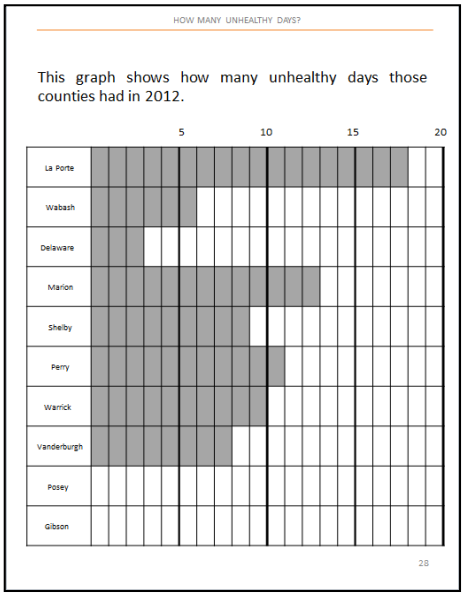
Air pollution effects on the developing respiratory system (Source: [UCLA Institute of the Environment and Sustainability](#))

TEACHER GUIDE

The map and the bar graph represent the number of unhealthy days for elder people and children in 10 counties in Indiana in 2012. Students are asked to create and interpret a bar graph and compare numbers of unhealthy days among given counties in Indiana. The map and the bar graph are created based on data obtained from [AirCompare](#).



MAP: page 23



Bar graph: page 24

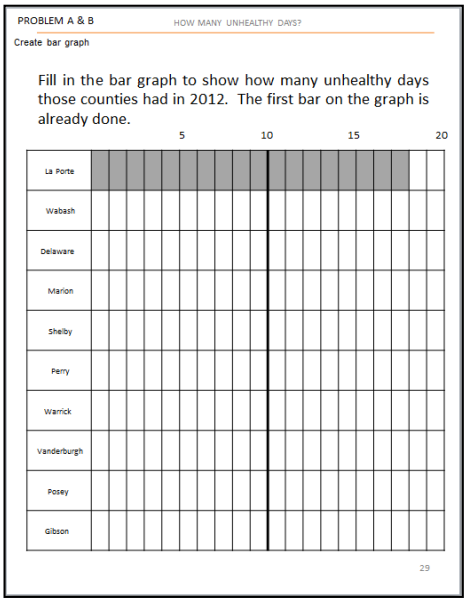
PROBLEM A

- *Bar graphs (up to number 20)*
- *Using <, >, = symbols*

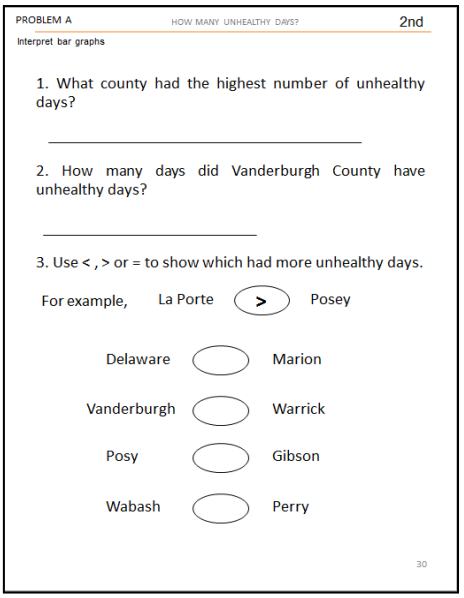
Students are asked to create a bar graph that compares the number of unhealthy days in 10 counties in Indiana in 2012. They use the symbols <, >, and = to compare numbers.

Note

If your students are not ready for creating graphs, use the graph on page 24.


PROBLEM A & B HOW MANY UNHEALTHY DAYS?
Create bar graph
Fill in the bar graph to show how many unhealthy days those counties had in 2012. The first bar on the graph is already done.
5 10 15 20
La Porte
Wabash
Delaware
Marion
Shelby
Perry
Warrick
Vanderburgh
Posey
Gibson
29

P 25—Student Sheet

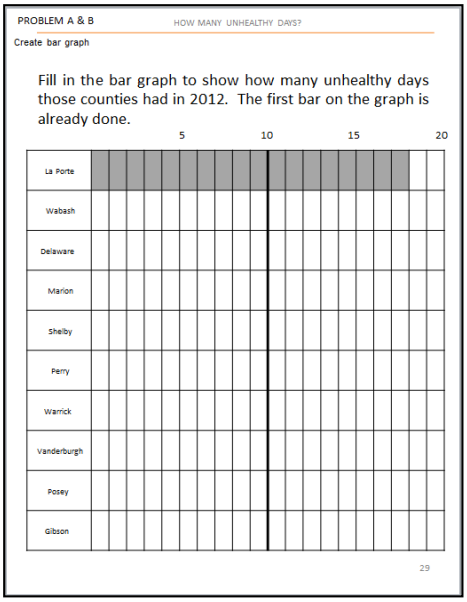

PROBLEM A HOW MANY UNHEALTHY DAYS? 2nd
Interpret bar graphs
1. What county had the highest number of unhealthy days?
2. How many days did Vanderburgh County have unhealthy days?
3. Use < , > or = to show which had more unhealthy days.
For example, La Porte > Posey
Delaware ◯ Marion
Vanderburgh ◯ Warrick
Posy ◯ Gibson
Wabash ◯ Perry
30

P 26—Student Sheet

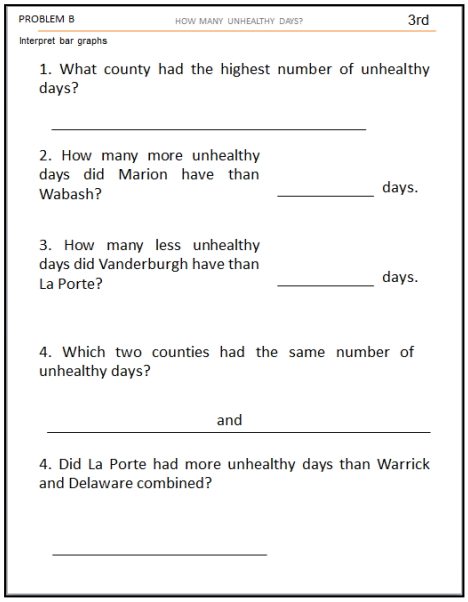
PROBLEM B

- *Bar graphs (up to number 20)*
- *Addition & Subtraction*

Students are asked to create a bar graph that compares the number of unhealthy days in 10 counties in Indiana in 2012. They answer questions related to the bar graph. They also use addition and subtraction to answer questions.

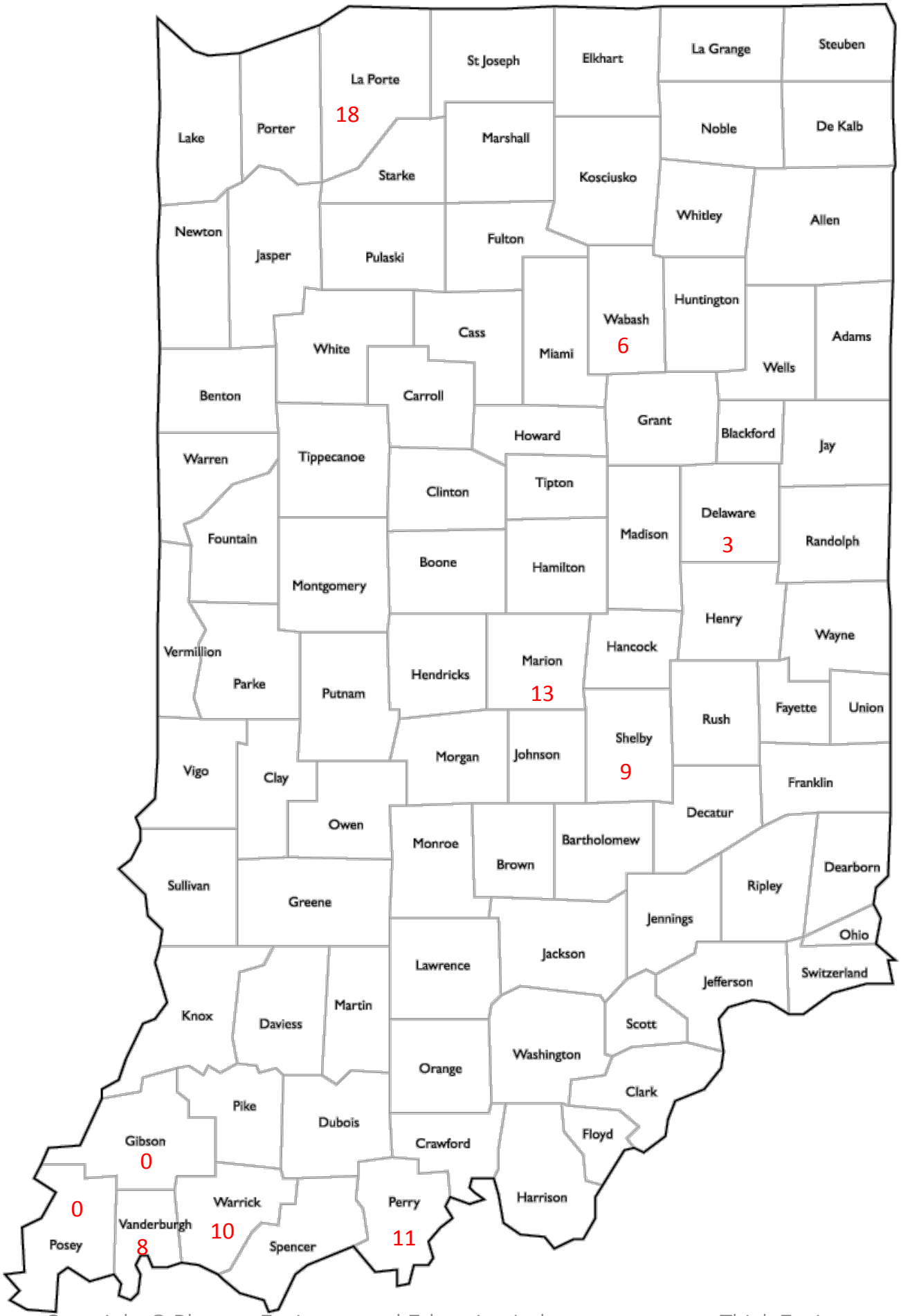

PROBLEM A & B HOW MANY UNHEALTHY DAYS?
Create bar graph
Fill in the bar graph to show how many unhealthy days those counties had in 2012. The first bar on the graph is already done.
5 10 15 20
La Porte
Wabash
Delaware
Marion
Shelby
Perry
Warrick
Vanderburgh
Posey
Gibson
29

P 25—Student Sheet

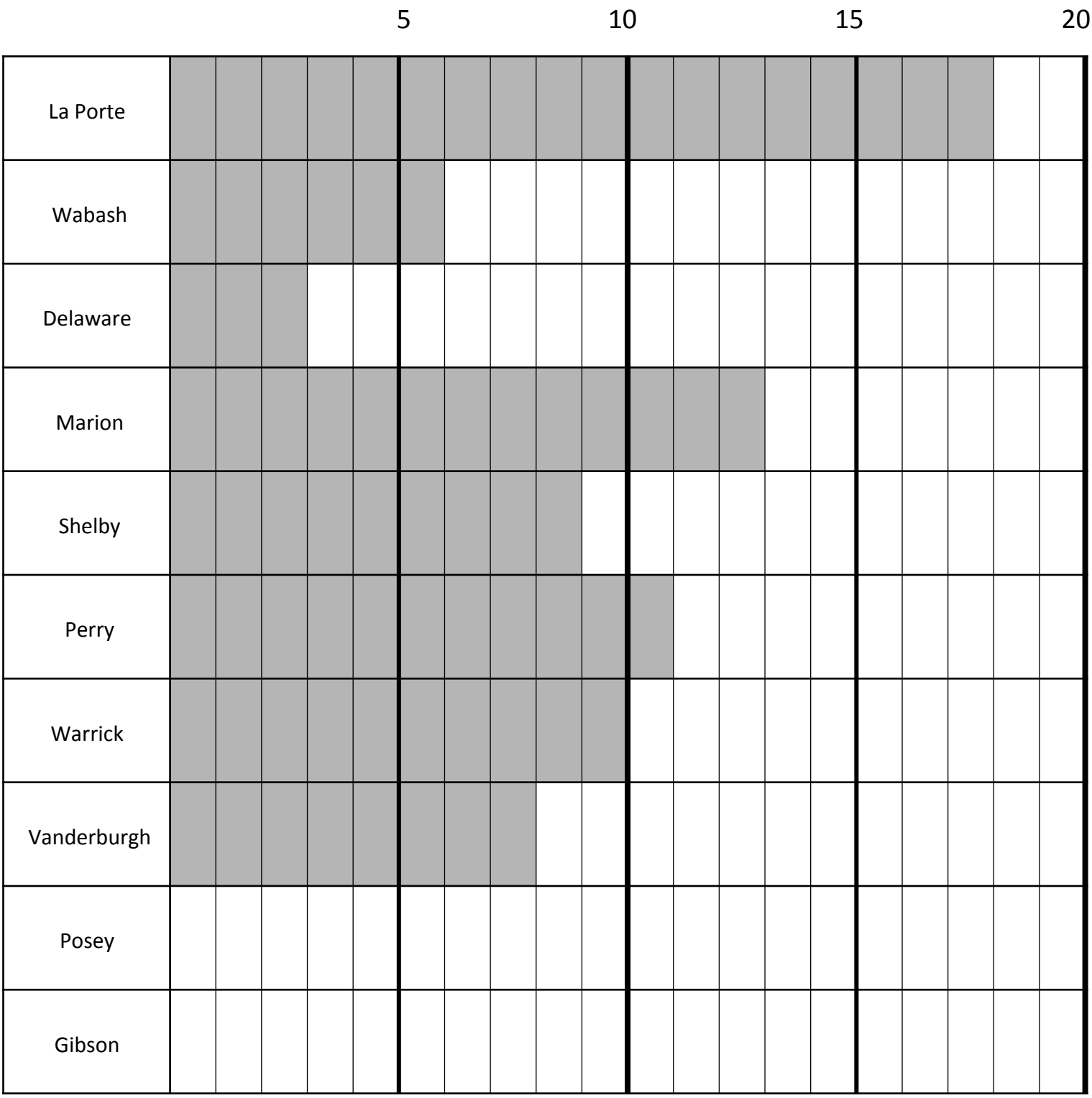

PROBLEM B HOW MANY UNHEALTHY DAYS? 3rd
Interpret bar graphs
1. What county had the highest number of unhealthy days?
2. How many more unhealthy days did Marion have than Wabash? _____ days.
3. How many less unhealthy days did Vanderburgh have than La Porte? _____ days.
4. Which two counties had the same number of unhealthy days?
_____ and _____
4. Did La Porte had more unhealthy days than Warrick and Delaware combined?

P 27—Student Sheet

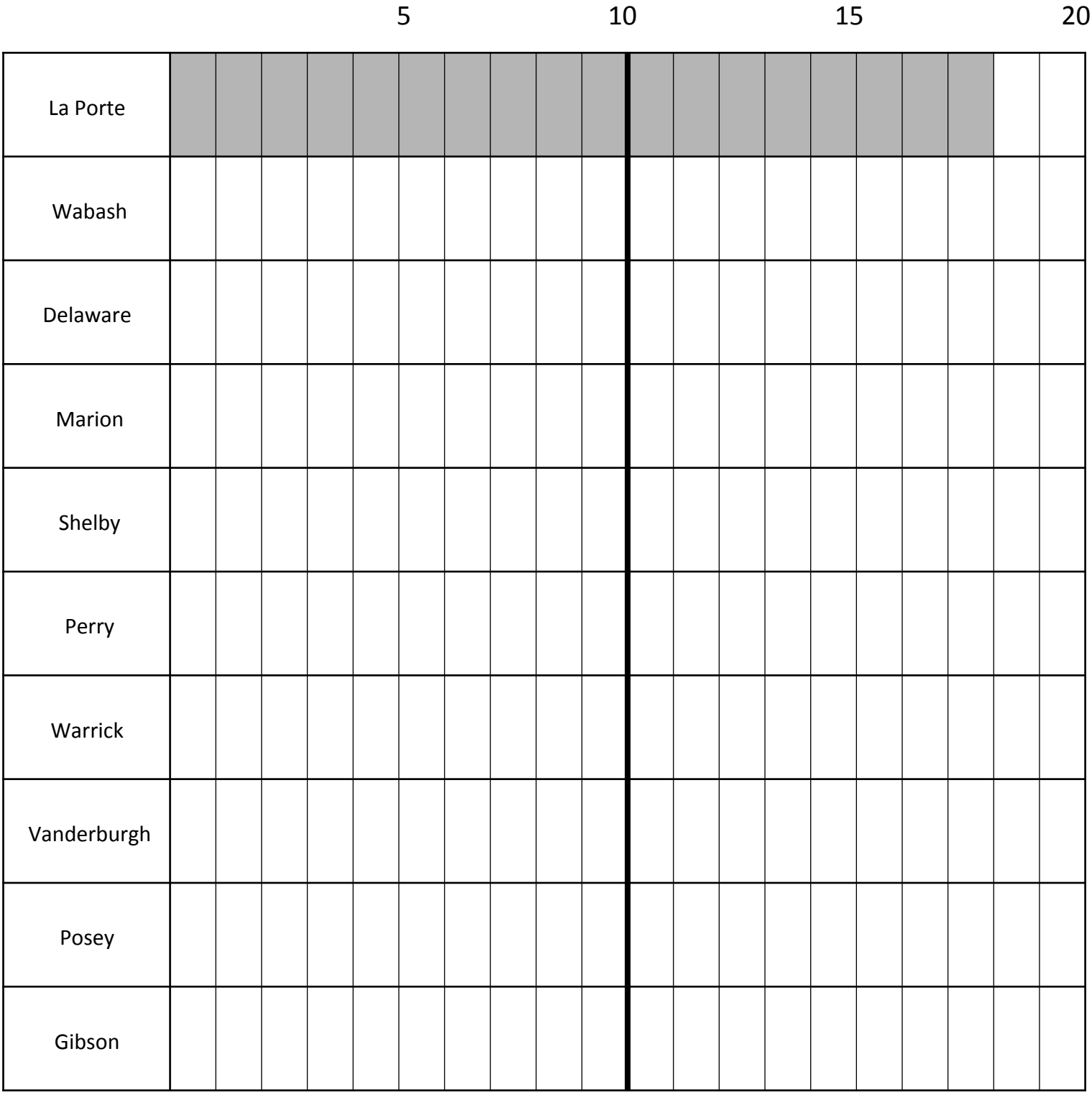
Number of unhealthy days in 10 counties in Indiana (2012)



This graph shows how many unhealthy days the counties had in 2012.



Fill in the bar graph to show how many unhealthy days the counties had in 2012. The first bar on the graph is already done for you.



1. What county had the highest number of unhealthy days?

_____

2. How many unhealthy days did Vanderburgh County have in 2012?

_____

3. Use < , > or = to show which had more unhealthy days.

For example, La Porte > Posey

Delaware ( ) Marion

Vanderburgh ( ) Warrick

Posey ( ) Gibson

Wabash ( ) Perry

1. What county had the highest number of unhealthy days?

_____

2. How many more unhealthy days did Marion have than Wabash? _____ days.

3. How many fewer unhealthy days did Vanderburgh have than La Porte? _____ days.

4. Which two counties had the same number of unhealthy days?

and

_____

5. Did La Porte have fewer unhealthy days than Warrick and Delaware combined?

_____

PROBLEM 4

Data Analysis

G2 G3 G4 Bar graphs (up to number 31)

G2 G3 G4 Using >, <, = symbols

Number & Operations

G2 G3 G4 Subtraction (2-digit numbers)

GOT HEALTHIER AIR IN VANDERBURGH?

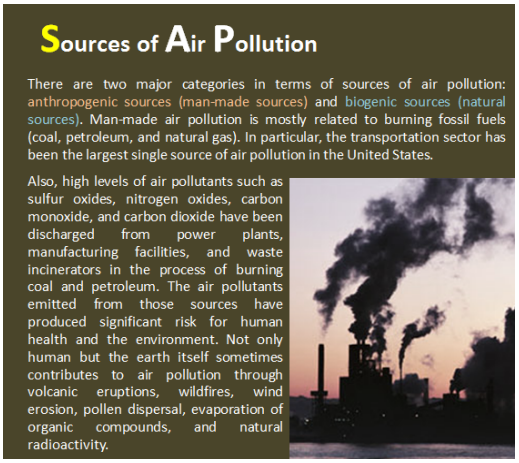
PURPOSE

Through this activity, **2nd -4th grade** students will

- Interpret bar graphs—**PROBLEM A & B**
- Use the symbols <, >, and = to compare numbers—**PROBLEM A**
- Subtract numbers (2-digit numbers)—**PROBLEM B**
- Understand trends in air quality in Vanderburgh county over the last 10 years
- Develop awareness of air quality

BACKGROUND FOR THE TEACHER

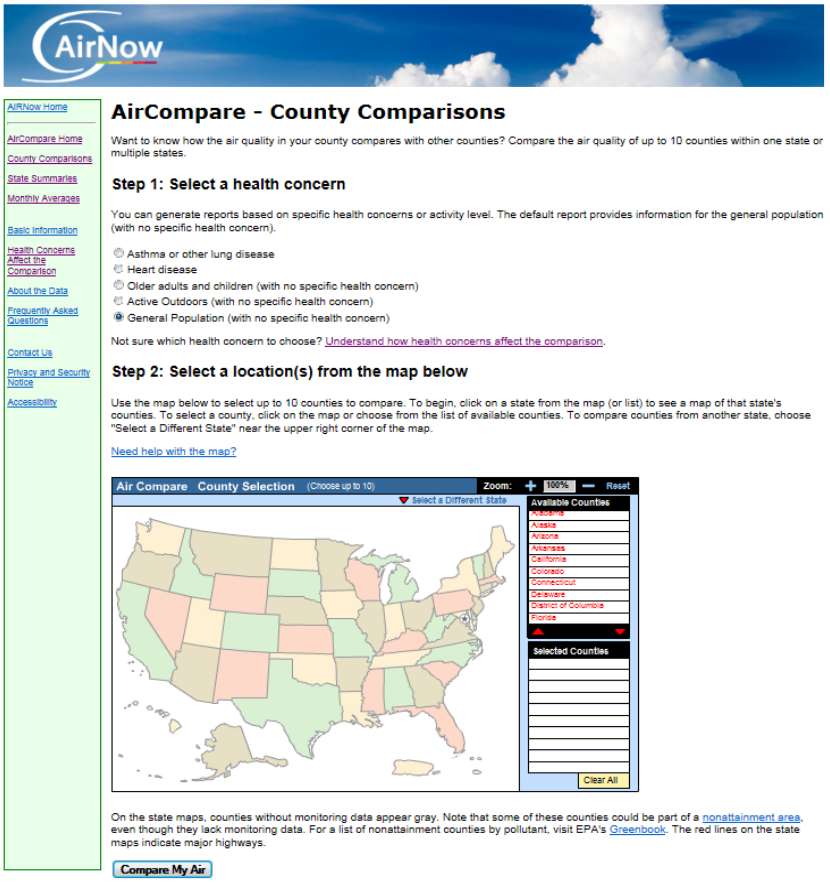
There are many sources that cause air pollution. Burning fossil fuels for electricity generation and transportation purposes are two of the major contributing factors to air pollution caused by human activity. (*More information on sources of air pollution on page 2*).



Sources of air pollution (page 2)

Air quality in the Evansville area has been improved over the last three decades due to a variety of clean air programs put in place nationally, regionally, and locally.

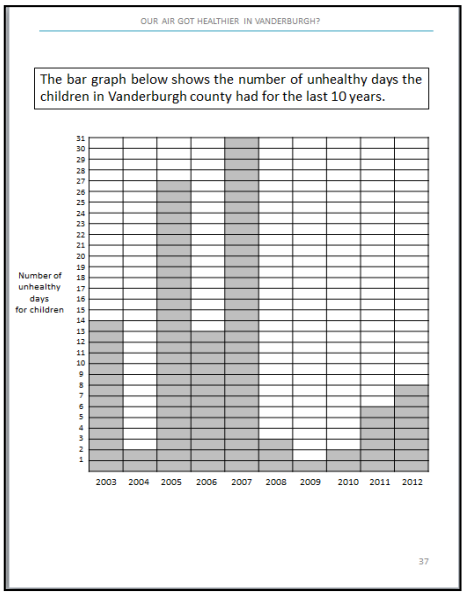
AirNow provides records of the number of unhealthy days in all counties in the United States over the last ten years.



Available from: http://www.epa.gov/aircompare/

TEACHER GUIDE

The bar graph represents the number of unhealthy days for elder people and children in Vanderburgh County in Indiana over the last 10 years. Students improve use skills on interpreting bar graphs through comparing the number of unhealthy days. This bar graph is created based on the data obtained from AirCompare.

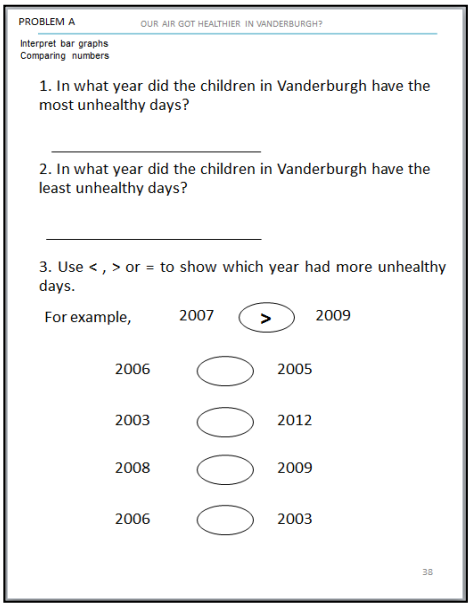


Bar graph (page 31)

PROBLEM A

- *Bar graphs (up to number 31)*
- *Using <, >, = symbols*

Using the bar graph on page 31, students are asked to compare the number of unhealthy days in Vanderburgh County over the last 10 years. They use the symbols <, >, and = to compare numbers.



PROBLEM A OUR AIR GOT HEALTHIER IN VANDERBURGH?

Interpret bar graphs
Comparing numbers

1. In what year did the children in Vanderburgh have the most unhealthy days?

_____

2. In what year did the children in Vanderburgh have the least unhealthy days?

_____

3. Use < , > or = to show which year had more unhealthy days.

For example, 2007 > 2009

2006 ◯ 2005

2003 ◯ 2012

2008 ◯ 2009

2006 ◯ 2003

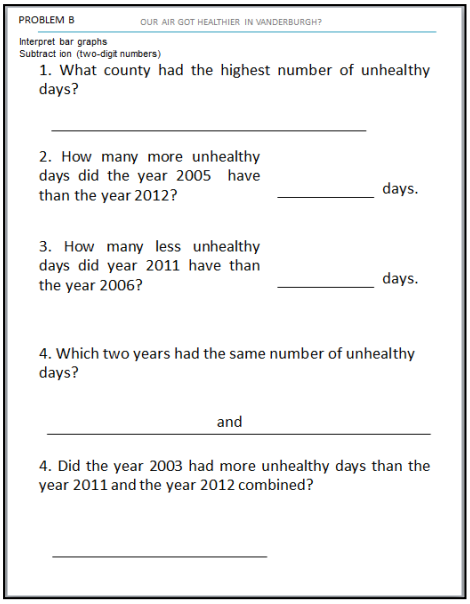
38

P 32—Student Sheet

PROBLEM B

- *Bar graphs (up to number 31)*
- *Subtraction (2-digit numbers)*

Students are asked to interpret a bar graph on page 31 that compares the number of unhealthy days in Vanderburgh County over the last 10 years. They respond to questions related to the bar graph. They also use subtraction (2 digit numbers) to answer questions.



PROBLEM B OUR AIR GOT HEALTHIER IN VANDERBURGH?

Interpret bar graphs
Subtract ion (two-digit numbers)

1. What county had the highest number of unhealthy days?

_____

2. How many more unhealthy days did the year 2005 have than the year 2012? _____ days.

3. How many less unhealthy days did year 2011 have than the year 2006? _____ days.

4. Which two years had the same number of unhealthy days?

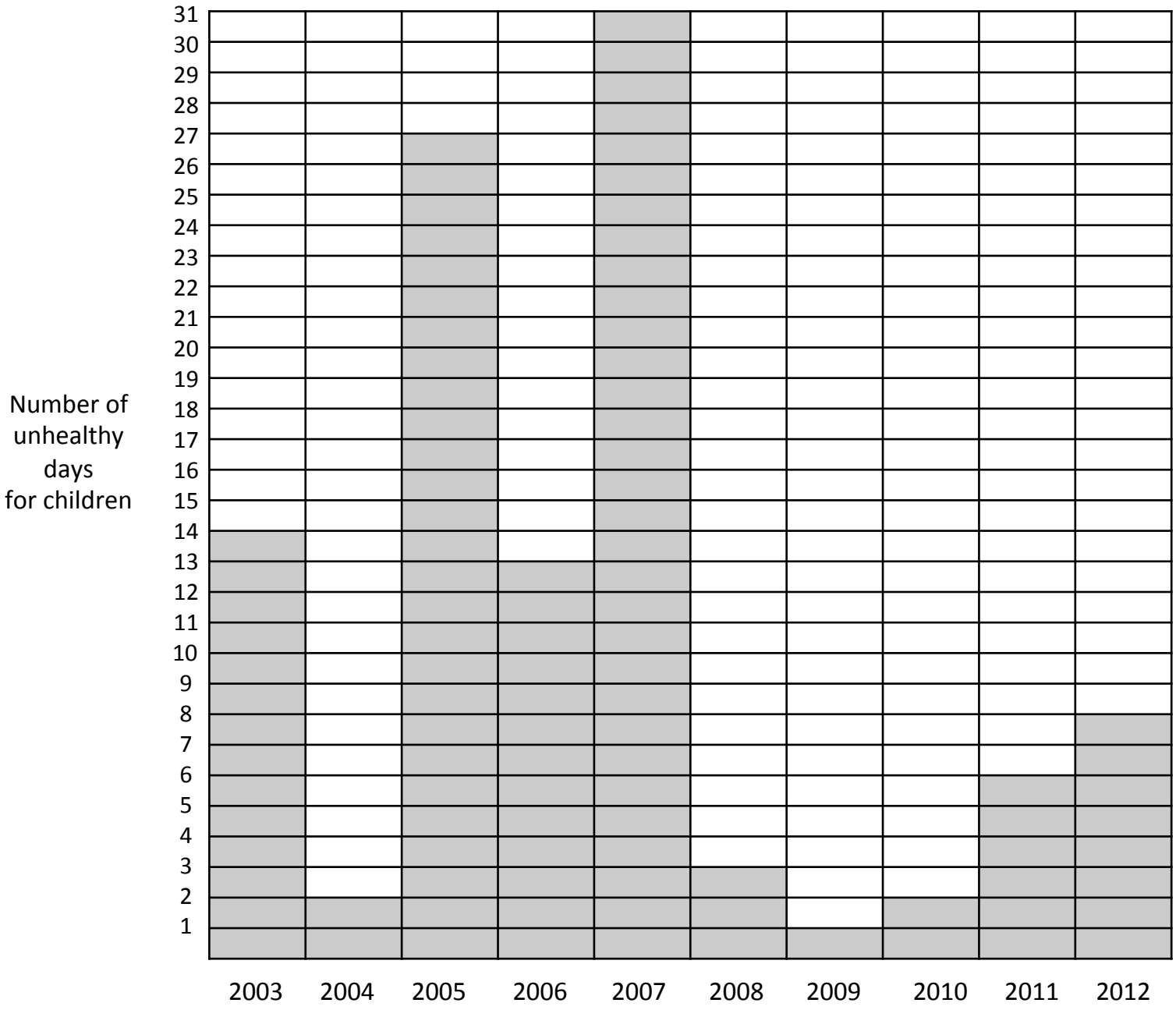
_____ and _____

4. Did the year 2003 had more unhealthy days than the year 2011 and the year 2012 combined?

_____

P 33—Student Sheet

The bar graph below shows how many unhealthy days for children Vanderburgh County had over the last 10 years.



1. In what year did the children in Vanderburgh have the largest number of unhealthy days?

_____

2. In what year did the children in Vanderburgh have the smallest number of unhealthy days?

_____

3. Use < , > or = to show which year had more unhealthy days.

For example, 2007 (>) 2009

2006 ( ) 2005

2003 ( ) 2012

2008 ( ) 2009

2006 ( ) 2003

1. In what year did the children in Vanderburgh have the largest number of unhealthy days?

_____

2. How many more unhealthy days did the year 2005 have than the year 2012? _____ days.

3. How many less unhealthy days did year 2011 have than the year 2006? _____ days.

4. Which two years had the same number of unhealthy days?

and

_____

4. Did the year 2003 have more unhealthy days than the year 2011 and the year 2012 combined?

_____

PROBLEM 5

Number & Operations

G3 G5	Subtraction (3 or 5 digits)
G3 G4 G5	Rounding (3, 4 or 5 digits)
G5	Estimating (5 digits)

Data Analysis

G5	Line graphs (5 digits)

IS OUR AIR GETTING CLEANER?

PURPOSE

Through this activity, **3rd grade** students will

- Subtract numbers (3-digit numbers)--**PROBLEM A**
- Round numbers (3-digit numbers)--**PROBLEM B**
- Understand trends of the amount of dust in our air since 1980
- Develop awareness of air quality

Through this activity, **4th grade** students will

- Round numbers (4-digit numbers)--**PROBLEM D**
- Understand trends in the amount of dust in our air since 1980
- Develop awareness of air quality

Through this activity, **5th grade** students will

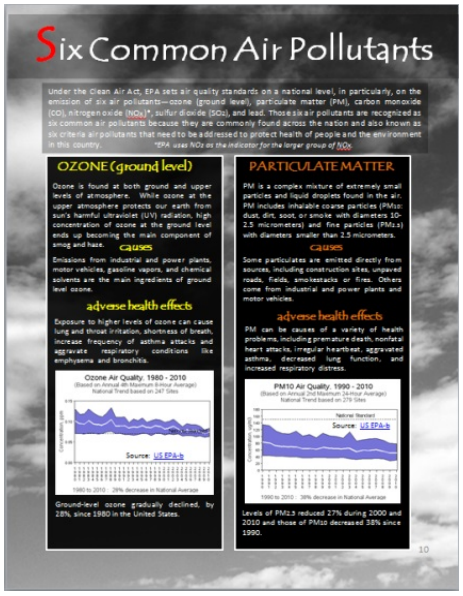
- Subtract numbers (5-digit numbers)--**PROBLEM C**
- Estimate difference (5-digit numbers)--**PROBLEM E**
- Round numbers (5-digit numbers)--**PROBLEM F**
- Create and interpret a line graph--**PROBLEM F**
- Understand trends in the amount of dust in our air since 1980
- Develop awareness of air quality

BACKGROUND FOR THE TEACHER

Air pollution happens when air pollutants in the form of gases, dust, fumes, and odors are sent into the air in a way that makes it harmful to life on Earth. Air pollutants include carbon monoxide, sulfur dioxide, sand/dust particulate, nitrogen oxide, and ground level ozone, and lead. (See page 3 & 4 for common air pollutants)

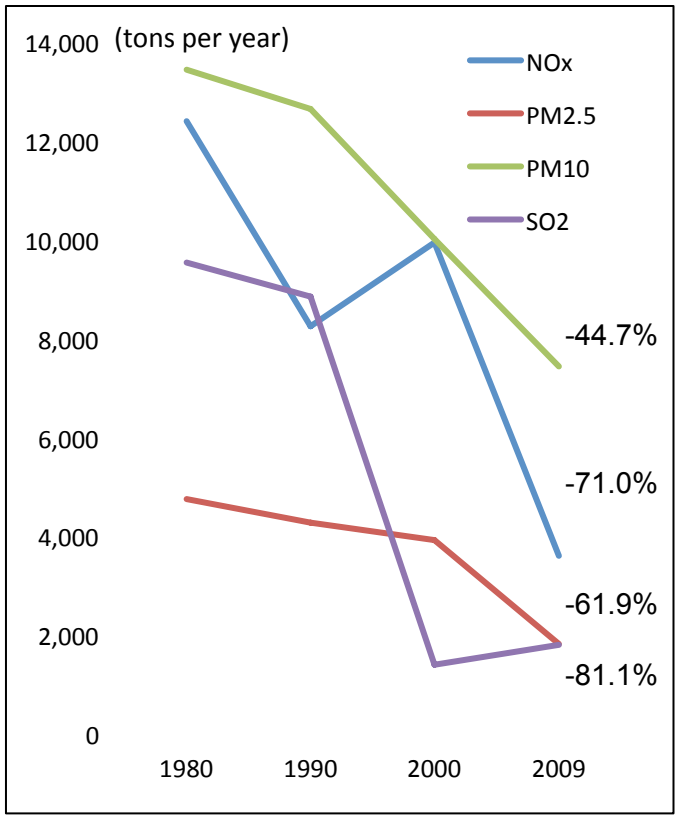
This activity uses the actual amount of dust particles, called particulate matters ($PM_{2.5}$ and PM_{10}), emitted in Vanderburgh County. Particulate matter is an air pollutant that is emitted into the atmosphere through human activities such as using cars, generating electricity, producing goods in factories, and constructing roads and buildings (see page 3 & 4 for details).

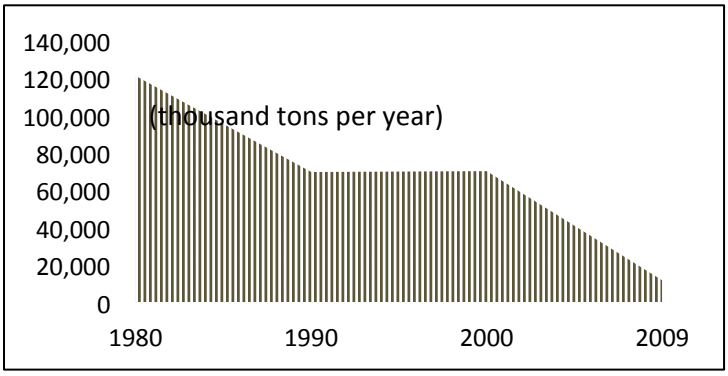
Exposure to particulate matter can cause respiratory problems and heart/lung disease.



Six common air pollutants (page 3-4)

Air quality in the Evansville area has improved over the last three decades due to a variety of clean air programs put in place nationally, regionally, and locally.





(Left) Trends of nitrogen oxides, particulate matter $_{2.5}$ and $_{10}$, and sulfur dioxide since 1980 in Vanderburgh County (Above) Carbon monoxide trend since 1980 in Vanderburgh County

Source: Criteria Pollutants Air Quality Trend Analysis Report (1980-2010), Indiana Department of Environmental Management

TEACHER GUIDE

This activity uses a table that represents the amount of particulate matter 10 (PM_{10}:inhalable coarse particles of dust, dirt, soot, or smoke with diameters 10-2.5 micrometers) emitted in Vanderburgh County in 1980, 1990, 2000 and 2009. Through this activity, students will strengthen their skills of number and operations and data analysis, while understanding trends of air pollution in Vanderburgh County since 1980.

Several levels of problems are provided for subtraction (PROBLEM A and C) and rounding problems (PROBLEM B, D and F) by using either 3, 4 or 5 digit numbers. Five digit numbers are used for PROBLEM E and F that ask students to estimate numbers and create and interpret line graphs.

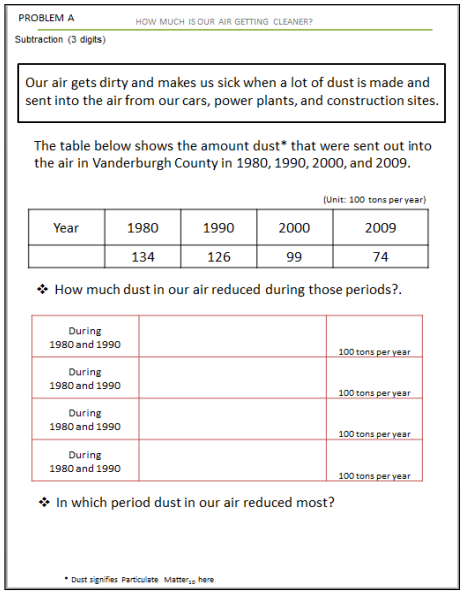
PROBLEM A

- *Subtraction (3-digit numbers)*

PROBLEM C

- *Subtraction (5-digit numbers)*

Using the numbers in the table, students are asked to compute how much the amount of dust reduced during 1980-1990, 1990-2000, 2000-2009.



PROBLEM A
HOW MUCH IS OUR AIR GETTING CLEANER?
Subtraction (3 digits)

Our air gets dirty and makes us sick when a lot of dust is made and sent into the air from our cars, power plants, and construction sites.

The table below shows the amount dust* that were sent out into the air in Vanderburgh County in 1980, 1990, 2000, and 2009.

(Unit: 100 tons per year)

Year	1980	1990	2000	2009
	134	126	99	74

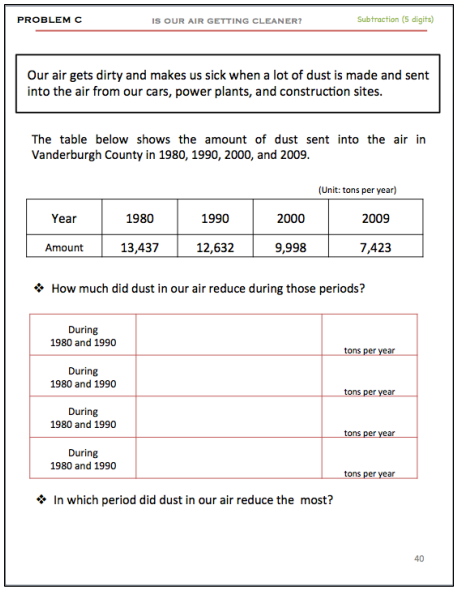
❖ How much dust in our air reduced during those periods?.

During 1980 and 1990		100 tons per year
During 1980 and 1990		100 tons per year
During 1980 and 1990		100 tons per year
During 1980 and 1990		100 tons per year

❖ In which period dust in our air reduced most?

* Dust signifies Particulate Matter$_{10}$ here

PROBLEM A: P 38—Student Sheet



PROBLEM C IS OUR AIR GETTING CLEANER? Subtraction (5 digits)

Our air gets dirty and makes us sick when a lot of dust is made and sent into the air from our cars, power plants, and construction sites.

The table below shows the amount of dust sent into the air in Vanderburgh County in 1980, 1990, 2000, and 2009.

(Unit: tons per year)

Year	1980	1990	2000	2009
Amount	13,437	12,632	9,998	7,423

❖ How much did dust in our air reduce during those periods?

During 1980 and 1990		tons per year
During 1980 and 1990		tons per year
During 1980 and 1990		tons per year
During 1980 and 1990		tons per year

❖ In which period did dust in our air reduce the most?

40

PROBLEM C: P 40—Student Sheet

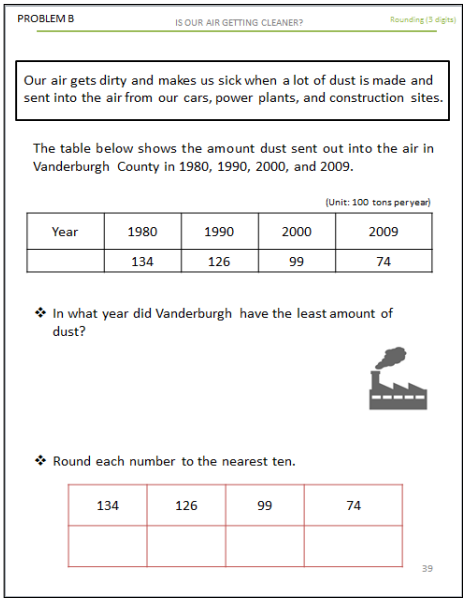
PROBLEM B

- *Rounding (3-digit numbers)*

PROBLEM D

- *Rounding (4-digit numbers)*

Using the numbers in the table, students are asked to round each number to the nearest 100 and 10.



PROBLEM B
IS OUR AIR GETTING CLEANER?
Rounding (3 digits)

Our air gets dirty and makes us sick when a lot of dust is made and sent into the air from our cars, power plants, and construction sites.

The table below shows the amount dust sent out into the air in Vanderburgh County in 1980, 1990, 2000, and 2009.

(Unit: 100 tons per year)

Year	1980	1990	2000	2009
	134	126	99	74

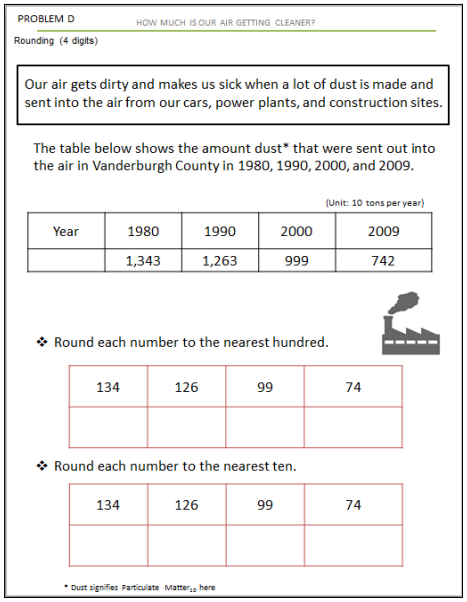
❖ In what year did Vanderburgh have the least amount of dust?

❖ Round each number to the nearest ten.

134	126	99	74

39

PROBLEM B: P 39—Student Sheet



PROBLEM D
HOW MUCH IS OUR AIR GETTING CLEANER?
Rounding (4 digits)

Our air gets dirty and makes us sick when a lot of dust is made and sent into the air from our cars, power plants, and construction sites.

The table below shows the amount dust* that were sent out into the air in Vanderburgh County in 1980, 1990, 2000, and 2009.

(Unit: 10 tons per year)

Year	1980	1990	2000	2009
	1,343	1,263	999	742

❖ Round each number to the nearest hundred.

134	126	99	74

❖ Round each number to the nearest ten.

134	126	99	74

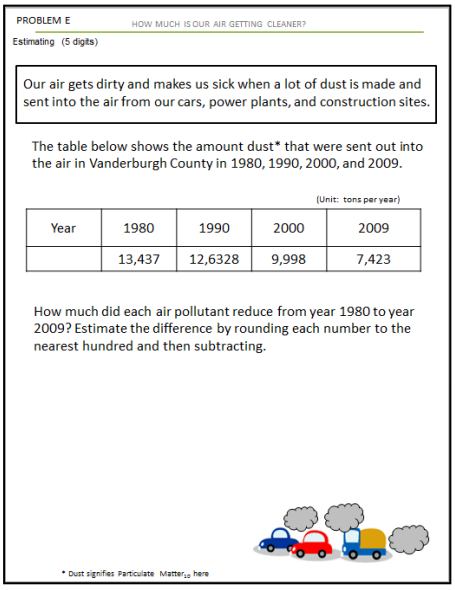
* Dust signifies Particulate Matter$_{10}$ here

PROBLEM D: P 41—Student Sheet

PROBLEM E

- *Estimate differences (5-digit numbers)*

Using the numbers in the table, students are asked to estimate how much the amount of dust reduced between 1980 and 2009.



PROBLEM E HOW MUCH IS OUR AIR GETTING CLEANER?

Estimating (5 digits)

Our air gets dirty and makes us sick when a lot of dust is made and sent into the air from our cars, power plants, and construction sites.

The table below shows the amount dust* that were sent out into the air in Vanderburgh County in 1980, 1990, 2000, and 2009.

(Unit: tons per year)

Year	1980	1990	2000	2009
	13,437	12,6328	9,998	7,423

How much did each air pollutant reduce from year 1980 to year 2009? Estimate the difference by rounding each number to the nearest hundred and then subtracting.

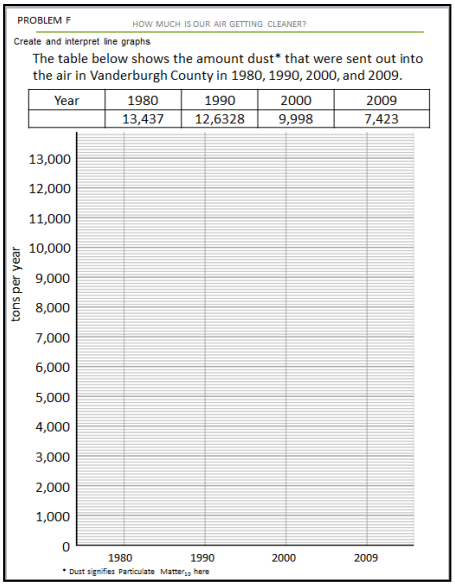
* Dust signifies Particulate Matter$_{2.5}$ here

P 42—Student Sheet

PROBLEM F

- *Line graphs (5-digit numbers)*
- *Rounding (5-digit numbers)*

Students are first asked to round 5-digit numbers. Using those rounded numbers, students are asked to create a line graph to show trends in the amount of dust in the air. They also answer questions related to the graph.



PROBLEM F HOW MUCH IS OUR AIR GETTING CLEANER?

Create and interpret line graphs

The table below shows the amount dust* that were sent out into the air in Vanderburgh County in 1980, 1990, 2000, and 2009.

Year	1980	1990	2000	2009
	13,437	12,6328	9,998	7,423

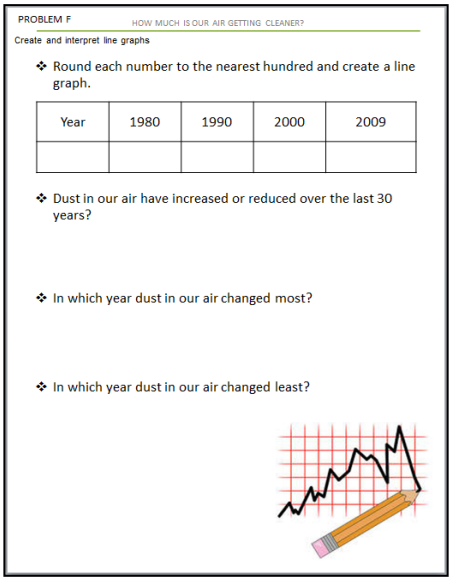
tons per year

13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0

1980 1990 2000 2009

* Dust signifies Particulate Matter$_{2.5}$ here

P 43—Student Sheet



PROBLEM F HOW MUCH IS OUR AIR GETTING CLEANER?

Create and interpret line graphs

- Round each number to the nearest hundred and create a line graph.

Year	1980	1990	2000	2009

- Dust in our air have increased or reduced over the last 30 years?
- In which year dust in our air changed most?
- In which year dust in our air changed least?

P 44—Student Sheet

Our air gets dirty and makes us sick when a lot of dust is made and sent into the air from our cars, power plants, and construction sites.

The table below shows the amount of dust sent into the air in Vanderburgh County in 1980, 1990, 2000, and 2009.

(Unit: 100 tons per year)

Year	1980	1990	2000	2009
Amount	134	126	99	74

❖ How much did dust in our air reduce during those periods?

Between 1980 and 1990		100 tons per year
Between1980 and 1990		100 tons per year
Between 1980 and 1990		100 tons per year
Between 1980 and 1990		100 tons per year

❖ In which period did dust in our air reduce the most?

Our air gets dirty and makes us sick when a lot of dust is made and sent into the air from our cars, power plants, and construction sites.

The table below shows the amount of dust sent out into the air in Vanderburgh County in 1980, 1990, 2000, and 2009.

(Unit: 100 tons per year)

Year	1980	1990	2000	2009
Amount	134	126	99	74

❖ In what year did Vanderburgh have the least amount of dust?

❖ Round each number to the nearest ten.

134	126	99	74

Our air gets dirty and makes us sick when a lot of dust is made and sent into the air from our cars, power plants, and construction sites.

The table below shows the amount of dust sent into the air in Vanderburgh County in 1980, 1990, 2000, and 2009.

(Unit: tons per year)

Year	1980	1990	2000	2009
Amount	13,437	12,632	9,998	7,423

❖ How much did dust in our air reduce during those periods?

During 1980 and 1990		tons per year
During 1980 and 1990		tons per year
During 1980 and 1990		tons per year
During 1980 and 1990		tons per year

❖ In which period did dust in our air reduce the most?

Our air gets dirty and makes us sick when a lot of dust is made and sent into the air from our cars, power plants, and construction sites.

The table below shows the amount of dust sent into the air in Vanderburgh County in 1980, 1990, 2000, and 2009.

(Unit: 10 tons per year)

Year	1980	1990	2000	2009
Amount	1,343	1,263	999	742

❖ Round each number to the nearest hundred.

134	126	99	74

❖ Round each number to the nearest ten.

134	126	99	74

Our air gets dirty and makes us sick when a lot of dust is made and sent into the air from our cars, power plants, and construction sites.

The table below shows the amount of dust sent into the air in Vanderburgh County in 1980, 1990, 2000, and 2009.

(Unit: tons per year)

Year	1980	1990	2000	2009
Amount	13,437	12,632	9,998	7,423

How much did dust reduce from 1980 to 2009? Estimate the difference by rounding each number to the nearest hundred and then subtracting.

The table below shows the amount of dust sent into the air in Vanderburgh County in 1980, 1990, 2000, and 2009.

Year	1980	1990	2000	2009
	13,437	12,632	9,998	7,423

- Round each number to the nearest hundred and create a line graph.

Year	1980	1990	2000	2009

- Did the amount of dust in our air increase or decrease over the last 30 years?

- In which year did dust in our air change most?

- In which year did dust in our air change least?

PROBLEM 6

Geometry

G3 G4 Identifying three-dimensional objects

WHAT NOT TO BURN FOR HEALTHIER AIR

PURPOSE

Through this activity, **3rd – 4th grade** students will

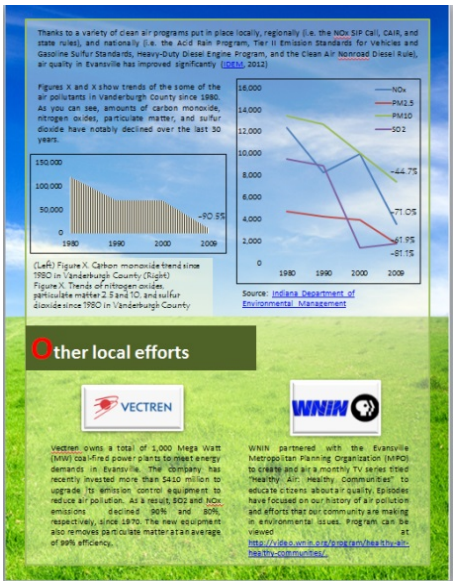
- Identify three-dimensional objects including rectangular prism, sphere, cylinder, and cone
- Understand things that we are prohibited from burning outside to protect our air quality in the City of Evansville
- Develop awareness of air quality

BACKGROUND FOR THE TEACHER

During the early 1900s, our air in Evansville was heavily polluted mainly due to the combustion of coal for energy generation, industrial production, and manufacturing. To improve our air quality in Vanderburgh County, the Evansville Environmental Protection (EPA) was established in 1970. (see page 5-6)

Who protects our air in Evansville? (page 5-6)

The Evansville EPA makes sure no one sends dirty things into our air. Inspectors from the Evansville EPA visit public and private places to make sure our air is kept clean. The Evansville EPA also sends warnings to people in the community on days when there is a chance that our air may affect our health. People in the City of Evansville need to call ***435-6145*** to let the Evansville EPA know before they burn materials outside because burning materials outside will pollute the air.



Who protects our air in Evansville? (page 5-6)

It is against the law to burn household trash, paper or plastics, leaves, grasses, wood that is painted, stained or glued, building materials, root balls or tree stumps.

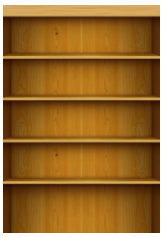
TEACHER GUIDE

The purpose of this activity is to 1) identify three-dimensional objects and 2) learn things that cannot be burned outside in Evansville to protect our air quality.

Pictures of some objects represent things that are prohibited from being burned in the City of Evansville. Through identifying the shapes of those items, students will enhance skills in three-dimensional objects.

Three problems are provided to match students' levels of understanding.



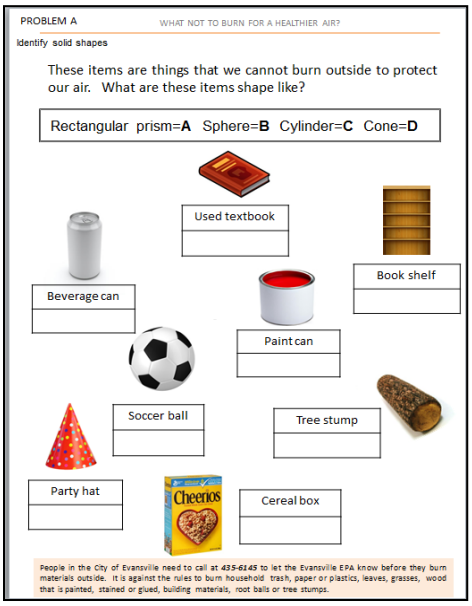




PROBLEM A

- *Identifying three-dimensional objects*

EASY

Students are asked to identify the shapes of the items by looking at the pictures of the items. Shapes include rectangular prism, sphere, cylinder, and cone.


PROBLEM A WHAT NOT TO BURN FOR A HEALTHIER AIR?

Identify solid shapes

These items are things that we cannot burn outside to protect our air. What are these items shape like?

Rectangular prism=**A** Sphere=**B** Cylinder=**C** Cone=**D**

Used textbook

Book shelf

Beverage can

Paint can

Soccer ball

Tree stump

Party hat

Cereal box

People in the City of Evansville need to call at ***435-6145*** to let the Evansville EPA know before they burn materials outside. It is against the rules to burn household trash, paper or plastics, leaves, grasses, wood that is painted, stained or glued, building materials, root balls or tree stumps.

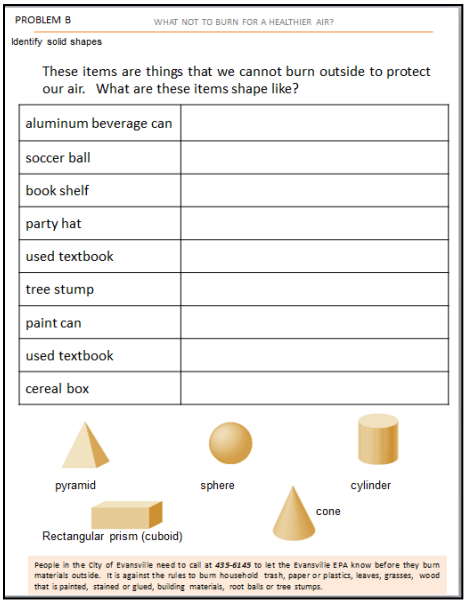
P 48—Student Sheet

PROBLEM B

- *Identifying three-dimensional objects*

Intermediate

Students are asked to identify the shapes of the item by imagining the shapes of the items on the list. Shapes include rectangular prism, pyramid, sphere, cylinder, and cone.


PROBLEM B WHAT NOT TO BURN FOR A HEALTHIER AIR?

Identify solid shapes

These items are things that we cannot burn outside to protect our air. What are these items shape like?

aluminum beverage can	
soccer ball	
book shelf	
party hat	
used textbook	
tree stump	
paint can	
used textbook	
cereal box	

pyramid sphere cylinder cone Rectangular prism (cuboid)

People in the City of Evansville need to call at ***435-6145*** to let the Evansville EPA know before they burn materials outside. It is against the rules to burn household trash, paper or plastics, leaves, grasses, wood that is painted, stained or glued, building materials, root balls or tree stumps.

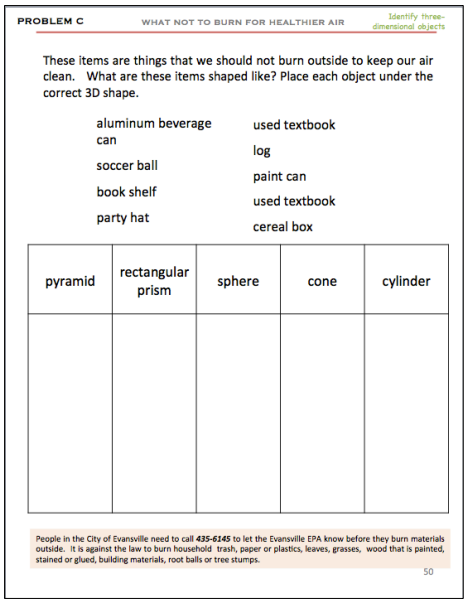
P 49—Student Sheet

PROBLEM C

- *Identifying three-dimensional objects*

Advanced

Students are asked to identify the shapes of the item by imagining the shapes of the items on the list. Shapes include rectangular prism, pyramid, sphere, cylinder, and cone.


PROBLEM C WHAT NOT TO BURN FOR HEALTHIER AIR Identify three-dimensional objects

These items are things that we should not burn outside to keep our air clean. What are these items shaped like? Place each object under the correct 3D shape.

aluminum beverage can
soccer ball
book shelf
party hat
used textbook
log
paint can
used textbook
cereal box

pyramid	rectangular prism	sphere	cone	cylinder

People in the City of Evansville need to call ***435-6145*** to let the Evansville EPA know before they burn materials outside. It is against the law to burn household trash, paper or plastics, leaves, grasses, wood that is painted, stained or glued, building materials, root balls or tree stumps.

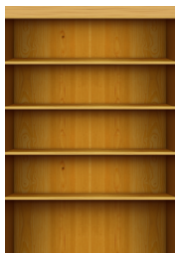
50

P 50—Student Sheet

These items are things that we should not burn outside to protect our air. What are these items shaped like?

Rectangular prism=**A** Sphere=**B** Cylinder=**C** Cone=**D**

Used textbook



Book shelf

Beverage can

Paint can

Soccer ball

Log

Party hat

Cereal box

People in the City of Evansville need to call ***435-6145*** to let the Evansville EPA know before they burn materials outside. It is against the low to burn household trash, paper or plastics, leaves, grasses, wood that is painted, stained or glued, building materials, root balls or tree stumps.

These items are things that we should not burn outside to keep our air clean. What are these items shaped like?

aluminum beverage can	
soccer ball	
book shelf	
party hat	
used textbook	
log	
paint can	
used textbook	
cereal box	

pyramid

sphere

cylinder

rectangular prism

cone

People in the City of Evansville need to call ***435-6145*** to let the Evansville EPA know before they burn materials outside. It is against the law to burn household trash, paper or plastics, leaves, grasses, wood that is painted, stained or glued, building materials, root balls or tree stumps.

These items are things that we should not burn outside to keep our air clean. What are these items shaped like? Place each object under the correct 3D shape.

aluminum beverage can

soccer ball

book shelf

party hat

used textbook

log

paint can

used textbook

cereal box

pyramid	rectangular prism	sphere	cone	cylinder

People in the City of Evansville need to call ***435-6145*** to let the Evansville EPA know before they burn materials outside. It is against the law to burn household trash, paper or plastics, leaves, grasses, wood that is painted, stained or glued, building materials, root balls or tree stumps.

PROBLEM 7

Data Analysis

G2
G3 Bar graphs (up to number 50)
G4
G5

G2 Use >, <, = symbols

Number &Operations

G2
G3 Subtraction (2 digit numbers)

G3
G4 Half and double the amount

G4
G5 Multiplication and division

WHO HAS THE CLEANEST CAR?

PURPOSE

Through this activity, **2nd grade** students will

- Create and interpret bar graphs
- Use the symbols <, >, and = to compare numbers--**PROBLEM A**
- Understand the concept of fuel economy
- Develop awareness of air quality

Through this activity, **2nd -3rd grade** students will

- Create and interpret bar graphs
- Subtract 2-digit numbers--**PROBLEM B**
- Understand concept of fuel economy
- Develop awareness of air quality

Through this activity, **3rd -4th grade** students will

- Create and interpret bar graphs
- Half and double amounts--**PROBLEM C**
- Understand the concept of fuel economy
- Develop awareness of air quality

Through this activity, **4 -5th grade** students will

- Create and interpret bar graphs
- Use multiplication and division--**PROBLEM D**
- Understand the concept of fuel economy
- Develop awareness of air quality

BACKGROUND FOR THE TEACHER

Burning oil (gasoline or diesel) in motor vehicles is the biggest cause of air pollution in the United States. How much gasoline your car uses is strongly connected to how dirty the air in your area is. If your car can run longer using the same amount of gasoline as your friend's car, your car sends less air polluting gases into the air. That means your car is better at keeping our air clean. **Fuel economy** tells us how far a car can go on using one gallon of gasoline. The farther a car can go, the better fuel economy it has.

The U.S. Department of Energy provides information on the fuel economy of cars sold in the United States. You will be able to find out fuel economy of your car on their website. It also offers a ranking of the most and least efficient cars, as well as information on hybrid and electric vehicles.

Green Vehicles

The vehicles that burn gasoline and diesel fuel are still the main form of transportation. However, there are also vehicles in the market that use less gasoline and therefore emit less air pollutants.

❖ Hybrid-electric vehicles

Hybrid–electric vehicles combine gasoline engines and electric motors to improve fuel efficiency. Hybrid cars like the Toyota Prius produce 90% less air pollutants than traditional cars.

❖ Electric vehicles (EVs)

Electric vehicles (EVs() are powered by an electric motor. Because they do not either use or burn fossil fuels, electric vehicles emit no direct air pollution.

EV Charging Stations in Evansville

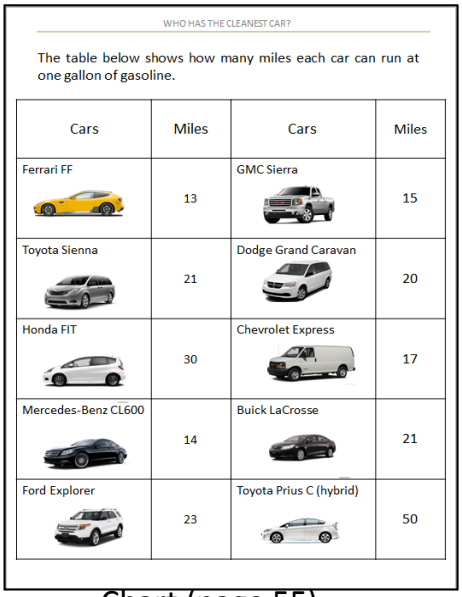
The City of Evansville's first municipal electric vehicle charging station was installed in 2011 for public use in the Sycamore Street Parking Garage, located at 500 Sycamore St. in Downtown Evansville. The charging station was purchased with Energy Efficiency and Conservation Block Grant (EECBG) funds from the U.S. Department of Energy.

Energy Systems Group, LLC, of Newburgh, Ind., donated two additional electric vehicle charging stations which were installed at the Locust Street Parking Garage and the Third Street Parking Garage. The charging stations are part of a larger energy efficiency project. The electricity needed to recharge an electric vehicle at one of these charging stations is offered at no cost to the vehicle owner.

Former Mayor Weinzapfel charging Plug-in Hybrid Vehicle

TEACHER GUIDE

The table and the bar graph show the fuel economy of 10 vehicles. Students use bar graphs skills through comparing the fuel efficiency of each car. There are 4 types of problems depending on grade levels. This activity is created based on data obtained from fueleconomy.gov. Use either the chart or the graph depending on students' level.

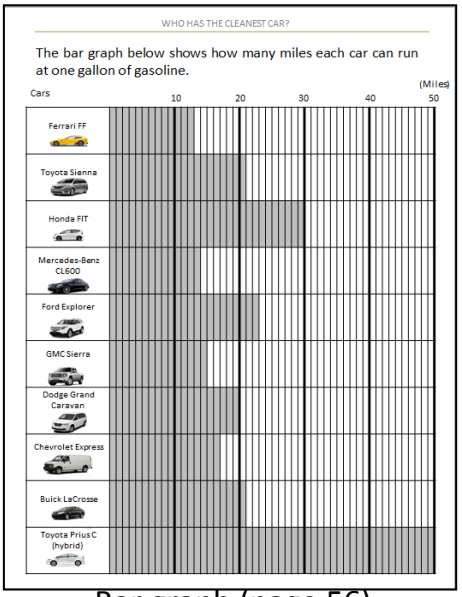


WHO HAS THE CLEANEST CAR?

The table below shows how many miles each car can run at one gallon of gasoline.

Cars	Miles	Cars	Miles
Ferrari FF	13	GMC Sierra	15
Toyota Sienna	21	Dodge Grand Caravan	20
Honda FIT	30	Chevrolet Express	17
Mercedes-Benz CL600	14	Buick LaCrosse	21
Ford Explorer	23	Toyota Prius C (hybrid)	50

Chart (page 55)



WHO HAS THE CLEANEST CAR?

The bar graph below shows how many miles each car can run at one gallon of gasoline.

Cars (Miles) 10 20 30 40 50

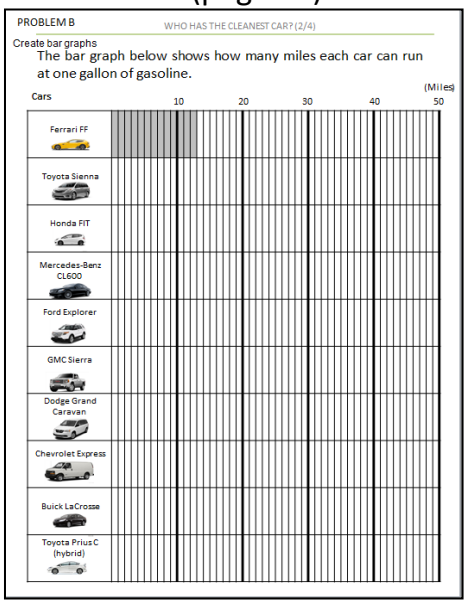
Ferrari FF, Toyota Sienna, Honda FIT, Mercedes-Benz CL600, Ford Explorer, GMC Sierra, Dodge Grand Caravan, Chevrolet Express, Buick LaCrosse, Toyota Prius C (hybrid)

Bar graph (page 56)

PROBLEM A

- *Bar graphs (up to 50)*
- *Using <, >, = symbols*

Using a chart, students are asked to create a bar graph that compares the fuel economy of 10 cars. They also use the symbols <, >, and = to compare the numbers.



PROBLEM B WHO HAS THE CLEANEST CAR? (2/4)

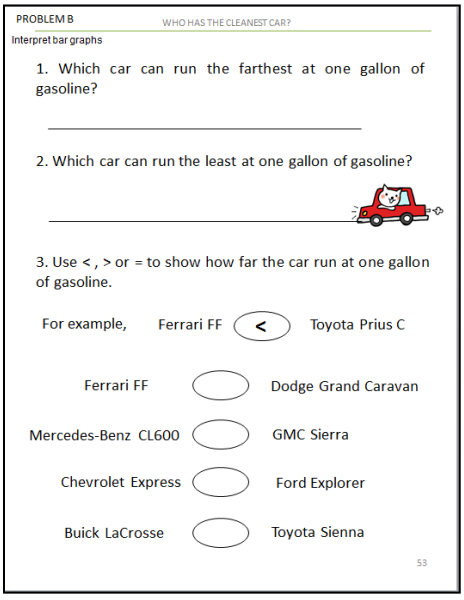
Create bar graphs

The bar graph below shows how many miles each car can run at one gallon of gasoline.

Cars (Miles) 10 20 30 40 50

Ferrari FF, Toyota Sienna, Honda FIT, Mercedes-Benz CL600, Ford Explorer, GMC Sierra, Dodge Grand Caravan, Chevrolet Express, Buick LaCrosse, Toyota Prius C (hybrid)

P57—Student Sheet



PROBLEM B WHO HAS THE CLEANEST CAR?

Interpret bar graphs

1. Which car can run the farthest at one gallon of gasoline?

2. Which car can run the least at one gallon of gasoline?

3. Use < , > or = to show how far the car run at one gallon of gasoline.

For example, Ferrari FF < Toyota Prius C

Ferrari FF ◯ Dodge Grand Caravan

Mercedes-Benz CL600 ◯ GMC Sierra

Chevrolet Express ◯ Ford Explorer

Buick LaCrosse ◯ Toyota Sienna

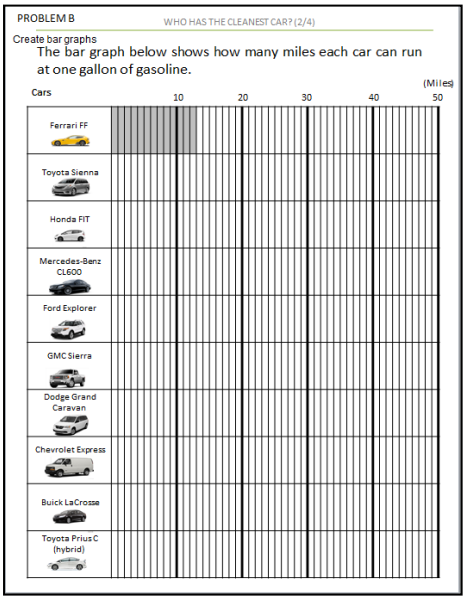
53

P58—Student Sheet

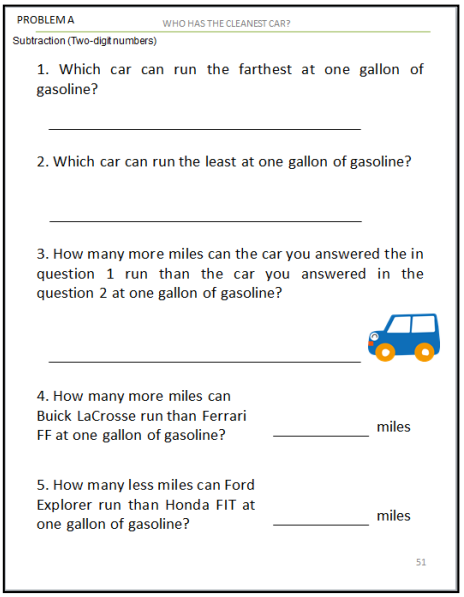
PROBLEM B

- *Subtraction (two-digit numbers)*

Using a chart, students are asked to create a bar graph and find out the most/least fuel-efficient car. They complete questions about the differences in fuel economy between two cars.



P 57—Student Sheet

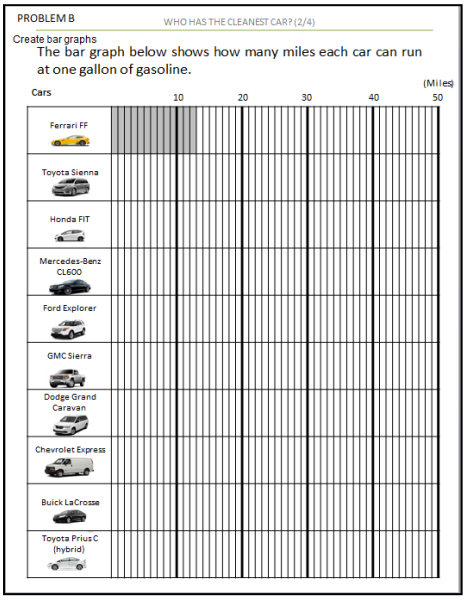


P 59—Student Sheet

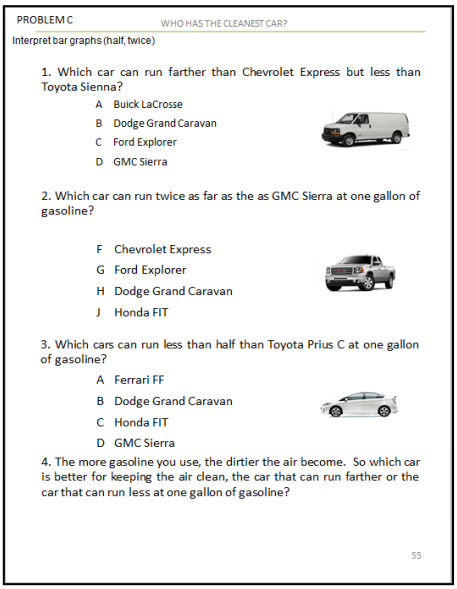
PROBLEM C

- *Bar graphs (up to 50)*
- *Half & Double*

Students are asked to create a bar graph that compares the fuel economy of 10 cars. They complete questions to find cars that have double/ half the fuel efficiency.



P 57—Student Sheet

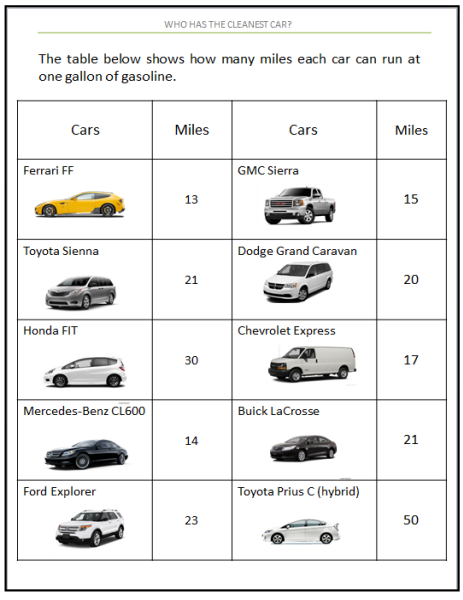


P 60—Student Sheet

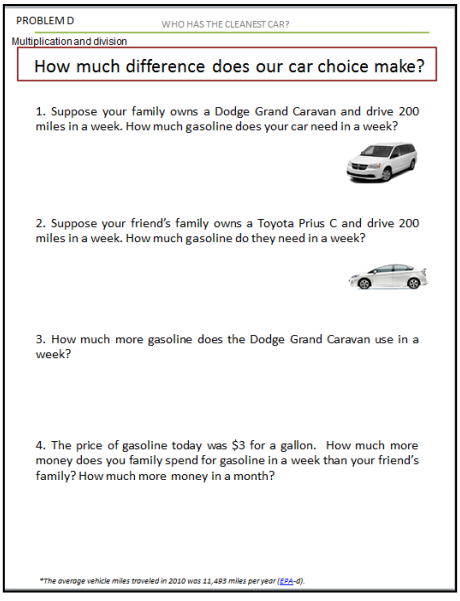
PROBLEM D

- *Multiplication and division*

Students are asked to find out the difference in gasoline use between two cars. Students complete questions using division and multiplication, such as 100/20 and 6x3. This problem uses data from the EPA that reports average vehicle miles traveled as 11,493 miles per year.



P 55—Student Sheet

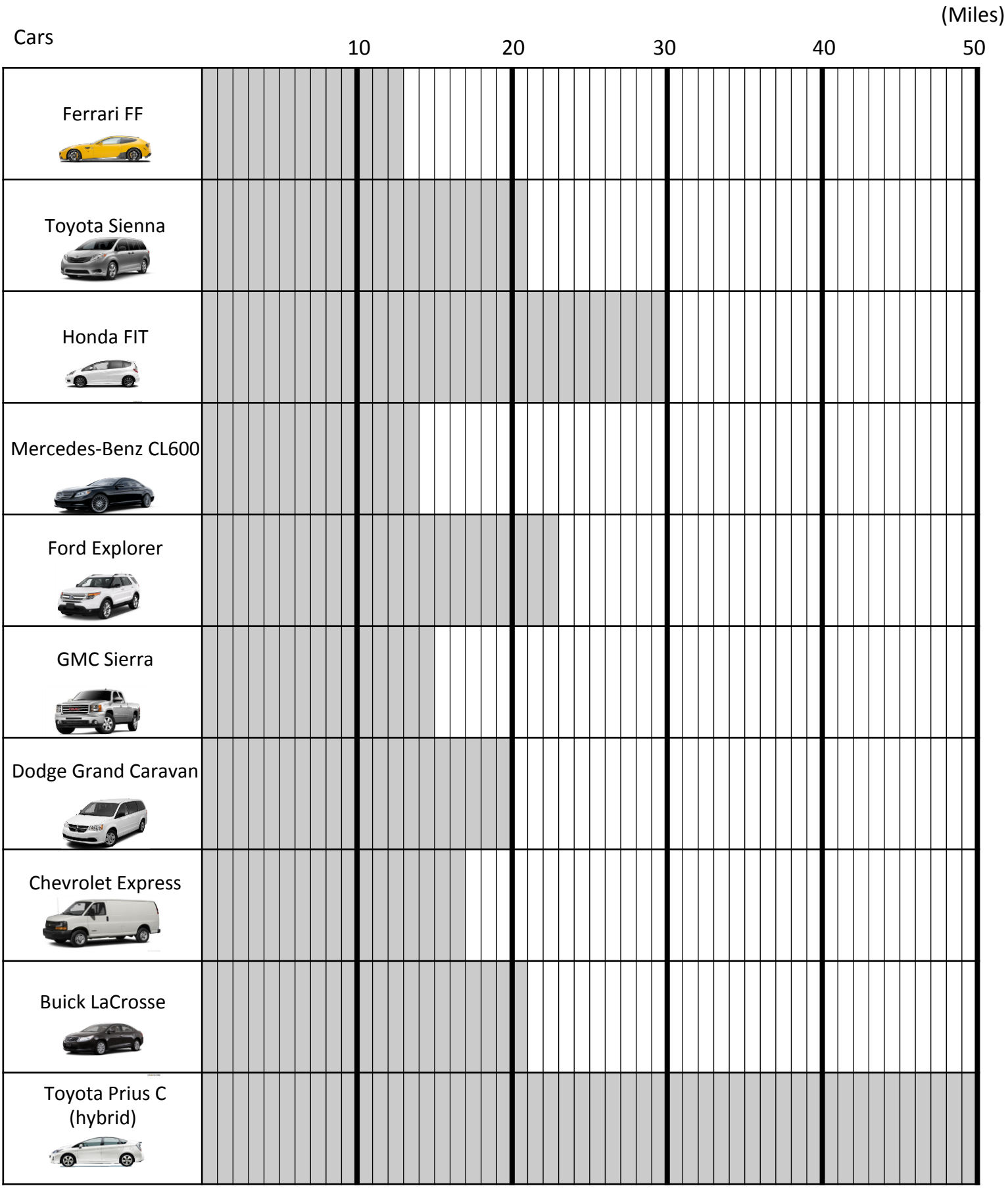


P 61—Student Sheet

The table below shows how many miles each car can go on one gallon of gasoline.

Cars	Miles	Cars	Miles
Ferrari FF 	13	GMC Sierra 	15
Toyota Sienna 	21	Dodge Grand Caravan 	20
Honda FIT 	30	Chevrolet Express 	17
Mercedes-Benz CL600 	14	Buick LaCrosse 	21
Ford Explorer 	23	Toyota Prius C (hybrid) 	50

The bar graph below shows how many miles each car can run on one gallon of gasoline.



The bar graph below shows how many miles each car can go on one gallon of gasoline.

Cars	10	20	30	40	50 (Miles)
Ferrari FF 					
Toyota Sienna 					
Honda FIT 					
Mercedes-Benz CL600 					
Ford Explorer 					
GMC Sierra 					
Dodge Grand Caravan 					
Chevrolet Express 					
Buick LaCrosse 					
Toyota Prius C (hybrid) 					

1. Which car can go the farthest on one gallon of gasoline?

_____

2. Which car can go the least far on one gallon of gasoline?

_____

3. Use < , > or = to show how far the car go on one gallon of gasoline.

For example, Ferrari FF (<) Toyota Prius C

Ferrari FF ( ) Dodge Grand Caravan

Mercedes-Benz CL600 ( ) GMC Sierra

Chevrolet Express ( ) Ford Explorer

Buick LaCrosse ( ) Toyota Sienna

1. Which car can go the farthest on one gallon of gasoline?

_____

2. Which car can go the least far on one gallon of gasoline?

_____

3. How many more miles can the car you wrote in question 1 go than the car you wrote in question 2 on one gallon of gasoline?

_____

4. How many more miles can a Buick LaCrosse run than a Ferrari FF on one gallon of gasoline? _____ miles

5. How many less miles can a Ford Explorer run than a Honda FIT on one gallon of gasoline? _____ miles

1. Which car can go farther than a Chevrolet Express but less than a Toyota Sienna on one gallon of gasoline?

A Buick LaCrosse

B Dodge Grand Caravan

C Ford Explorer

D GMC Sierra

2. Which car can go twice as far as the as a GMC Sierra on one gallon of gasoline?

F Chevrolet Express

G Ford Explorer

H Dodge Grand Caravan

J Honda FIT

3. Which cars can go less than half as far as a Toyota Prius C on one gallon of gasoline?

A Ferrari FF

B Dodge Grand Caravan

C Honda FIT

D GMC Sierra

4. The more gasoline you use, the dirtier the air becomes. So which car is best for keeping the air clean?

How much difference can our car choice make?

1. Suppose your family owns a Dodge Grand Caravan and drives 200 miles per week. How much gasoline does your car need per week?

2. Suppose your friend's family owns a Toyota Prius C and drives 200 miles per week. How much gasoline do they need per week?

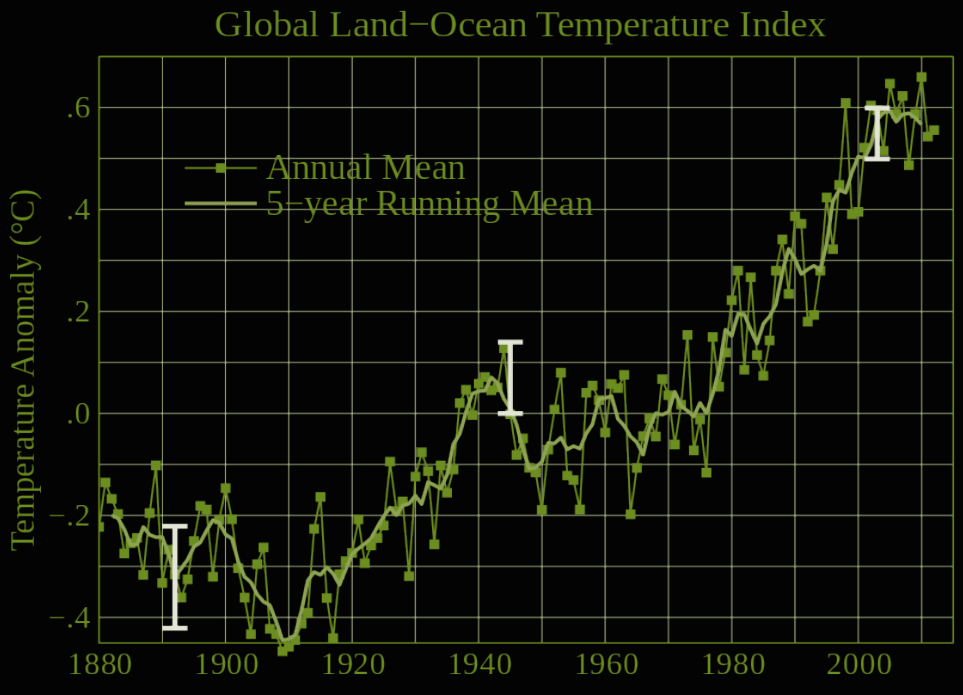
3. How much more gasoline does the Dodge Grand Caravan use per week?

4. If the price of gasoline today is $3 a gallon, how much more money does you family need to spend for gasoline in a week than your friend's family? How much more money in a month?

Climate Change

Scientists have discovered that the average temperature of the Earth's atmosphere and oceans has risen by about 1.4 °F since the early 20th century. It is projected to rise another 2 to 11.5°F over the next hundred years. Climate Scientists have warned that the results will be disastrous if current trends continue.

Rising global temperatures have been accompanied by *climate change*—significant and long-lasting change in weather. Many places have already experienced climate change such as increased frequency of intense rains, floods, droughts, snow, and extreme heat and heat waves. In 2012 alone, the United States experienced 3,527 weather records broken for heat, rain, and snow (NRDC).



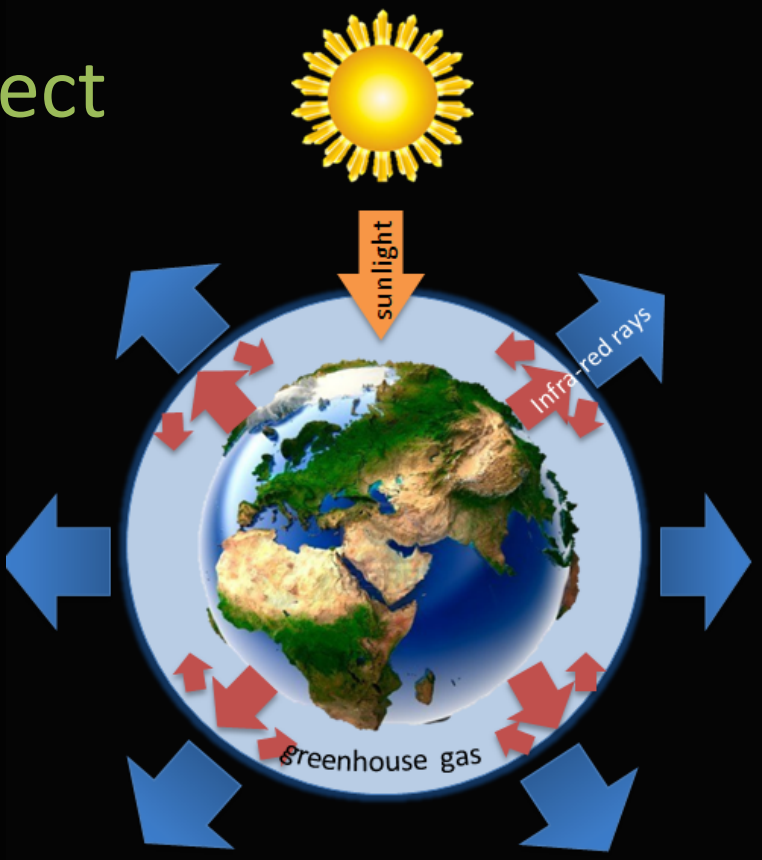
Global mean land-ocean temperature change from 1880–2012
Source: NASA, GISS

The Greenhouse Effect

Most climate scientists agree that the main cause of climate change is the enhanced *greenhouse effect*.

Our Earth has been kept warm through a process called the greenhouse effect. The Earth's surface heats up after the Earth gets energy from the sun in the form of sunlight. The Earth's surface cools down by releasing the heat (infra-red rays) back to outer space. But some of the heat is absorbed by layers of gases called *greenhouse gases* in the atmosphere, which keep the Earth warm at 59°F on average. Without these greenhouse gases, the Earth's surface would be about -2 °F on average. Scientific findings show that, due to the recent rising concentration of greenhouse gases in the atmosphere, the greenhouse effect has been enhanced and more heat emitted by the surface ends up being trapped by the atmosphere and bounced back to the surface, contributing to the rise of global temperature.

Climate scientists point out that the increase of greenhouse gas concentration is attributable to the increased amount of greenhouse gas emissions from a variety of human activities, such as burning fossil fuels for energy generation, transportation, and heating buildings, cutting down carbon-absorbing forests for agriculture, and disposing of waste in landfills. A study from NASA showed that, since the Industrial Revolution began in about 1750, carbon dioxide, one of the major greenhouse gases, increased by 38%, while methane, another major greenhouse gas, increased by 148% (NASA)



(Above) The Earth's surface heats up after the Earth gets energy from the sun in the form of sunlight. The Earth's surface cools down by releasing the heat (infra-red rays) back to outer space. But some of the heat is trapped by layers of gases called greenhouse gases in the atmosphere. (Below) Due to the recent increased concentration of greenhouse gases in the atmosphere, the greenhouse effect has been enhanced and more heat emitted by the surface ends up being trapped by the atmosphere, contributing to the rise of global temperature.

PROBLEM 8

Measurement

G5 Temperature

WHAT KEEPS EARTH WARM?

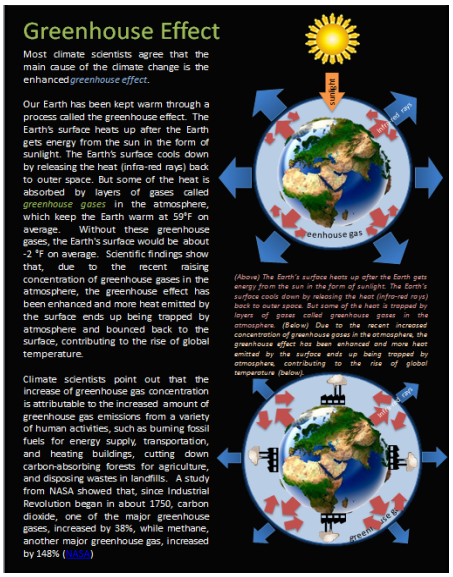
PURPOSE

Through this activity, **5th grade** students will

- Identify a tool to measure temperature
- Convert from Fahrenheit to Celsius by using a conversation table
- Understand the role of greenhouse gas on Earth and Venus
- Develop awareness of climate change

BACKGROUND FOR THE TEACHER

Our Earth has been kept warm through a process called the **greenhouse effect**. The Earth's surface heats up after the Earth gets energy from the sun in the form of sunlight. The Earth's surface cools down by releasing the heat (infra-red rays) back into outer space. But some of the heat is absorbed by layers of gases called ***greenhouse gases*** in the atmosphere, which keeps the Earth warm at 59°F on average (see information on the greenhouse effect on page 62).

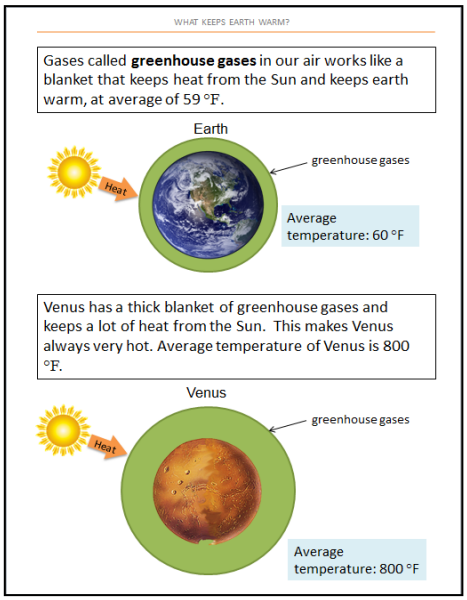


Greenhouse effect (page 62)

Without these greenhouse gases, the Earth's surface would be about -2 °F on average. Scientific findings show that, due to the recent rising concentration of greenhouse gases in the atmosphere, the greenhouse effect has been enhanced and more heat emitted by the surface ends up being trapped by the atmosphere and bounced back to the surface, contributing to the rise of global temperature.

TEACHER GUIDE

The figures compare temperature on Earth (60 °F) and Venus (800 °F). The average temperature of Venus is very hot because of a very thick layer of greenhouse gases surrounding the planet. Using average temperatures, students practice temperature skills in both Fahrenheit and Celsius.

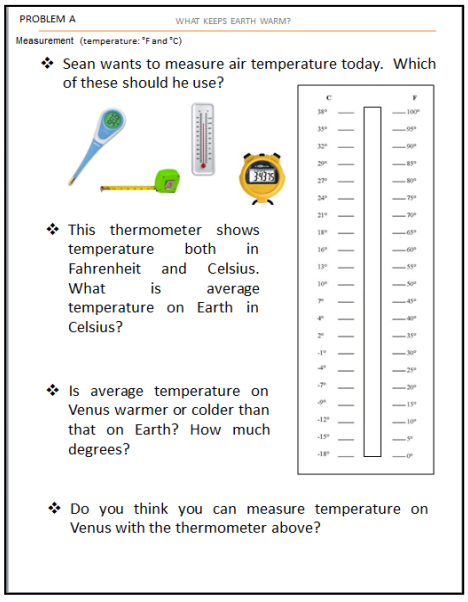


P 66—Student Sheet

PROBLEM

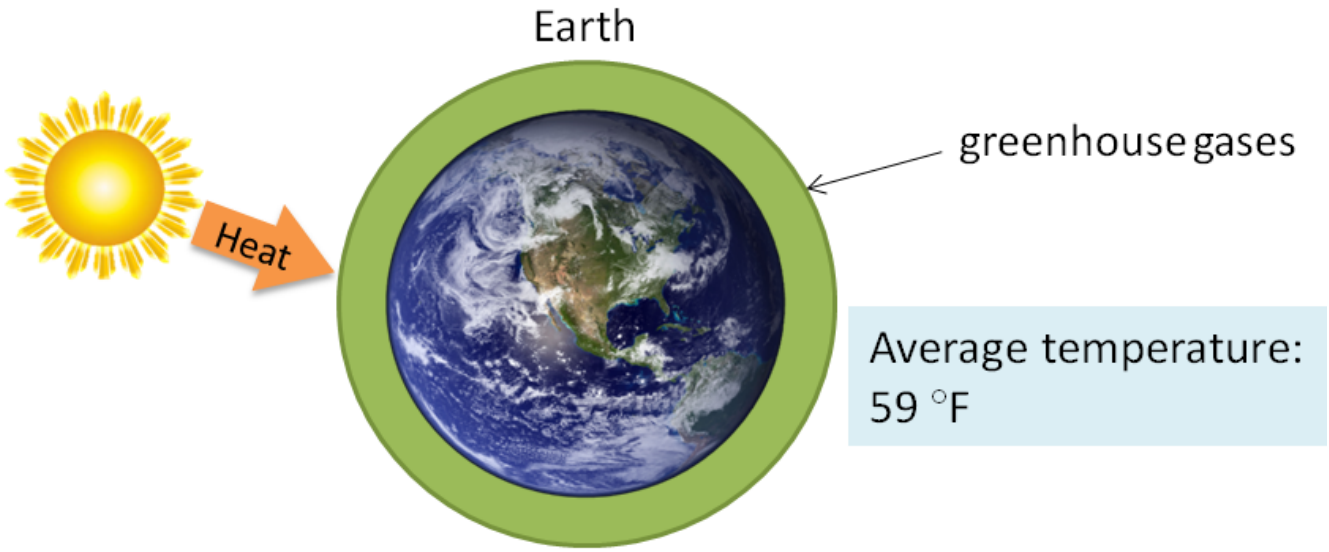
- *Measurement--Temperature*
  Fahrenheit and Celsius

Students are asked to pick a tool to measure temperature. Using the conversion table, students are also asked to find out an equivalent temperature on Earth in Celsius.

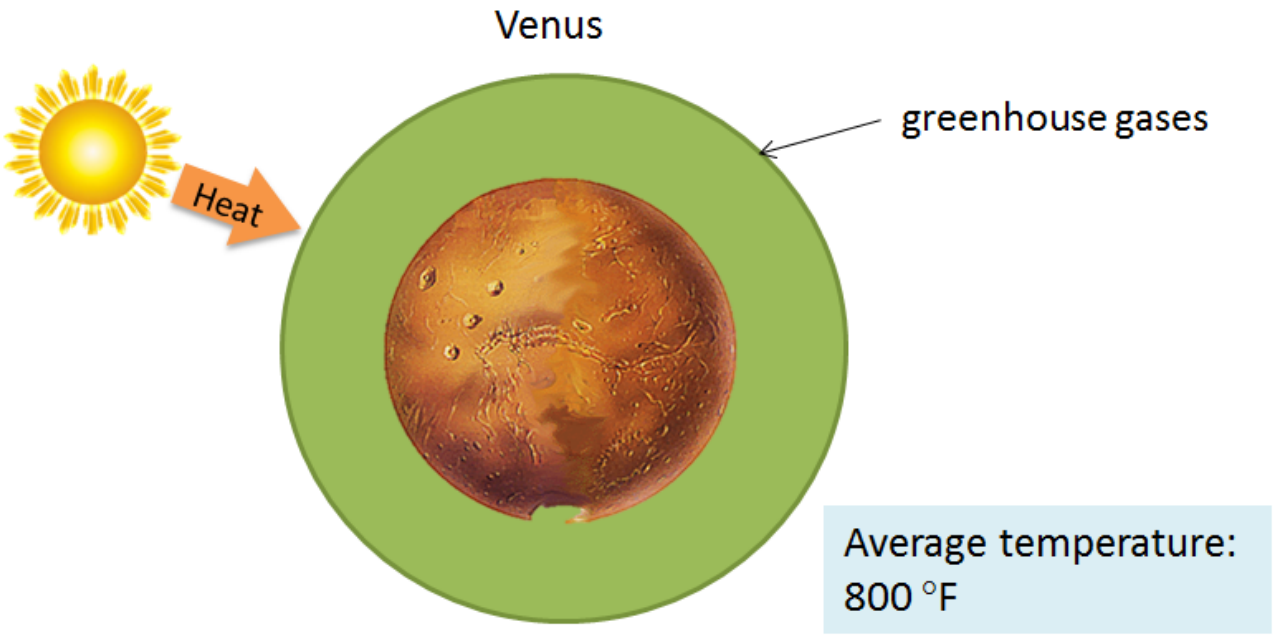


P 67—Student Sheet

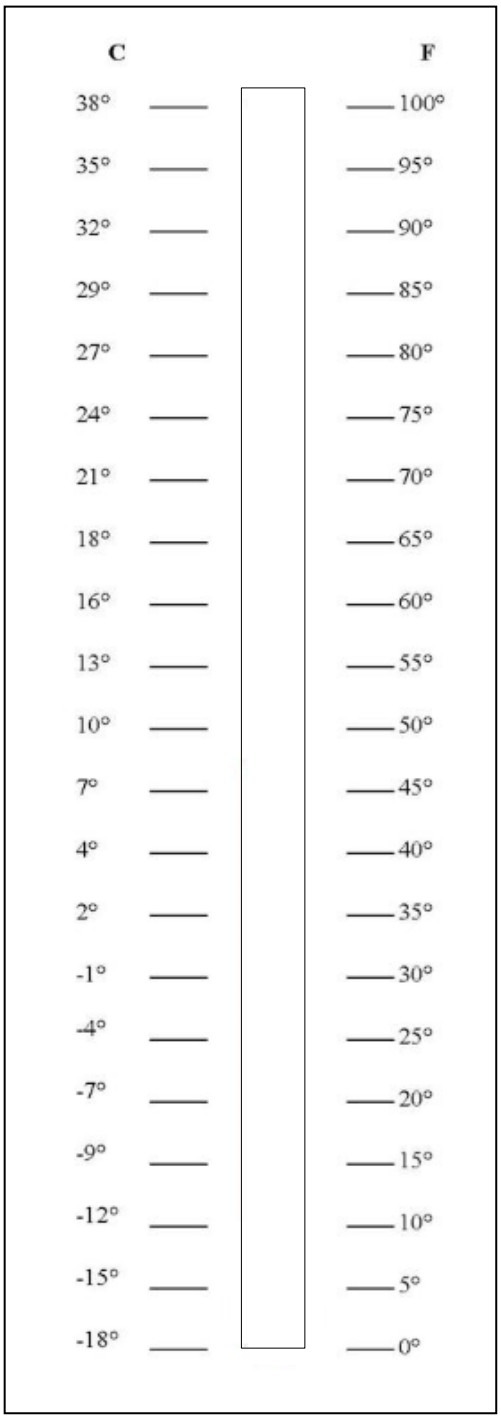
Gases called **greenhouse gases** in our atmosphere work like a blanket that keeps heat from the Sun and keeps the earth warm, at average of 59 °F.



Venus has a thick blanket of greenhouse gases and keeps a lot of heat from the Sun. This makes Venus always very hot. The average temperature of Venus is 800 °F.



- Sean wants to measure air temperature today. Which of these should he use?



- This thermometer shows temperature in both Fahrenheit and Celsius. What is the average temperature on Earth in Celsius?

- Is the average temperature on Venus warmer or colder than that on Earth? How many degrees in °F?

- Do you think you can measure the temperature on Venus with the thermometer above?

PROBLEM 9

Data Analysis

G5 Line graphs (up to 25)

Number and operations

G5 Fractions & percentages

PIKA & CLIMATE CHANGE

PURPOSE

Through this activity, **5th grade** students will

- Create and interpret line graphs
- Convert to percentages and fractions
- Understand effects of climate change on habitats of American Pikas
- Understand the concept of prediction
- Develop awareness of climate change

BACKGROUND FOR THE TEACHER

Scientists predict that the American Pika will be one of the fastest mammals to disappear because of climate change. The American Pika, a cousin of the rabbit, lives on mountain peaks in the Western United States.

Pikas live in cold alpine conditions and can die when exposed to temperature as mild as 78 degree F. Over the past century, the Pika's habitats have warmed about 1 degree F because of climate change. This has resulted in the disappearance of one-third of their habitats in Oregon and Nevada.

It has been predicted that the region will heat up an additional 4.5 to 14.4 degrees F during the next century. Since Pikas already live near the top of mountains, if the temperature keeps increasing, they simply lose places to live. Scientists predict Pikas will disappear from 80 percent of their habitat in the United States by the end of this century.

TEACHER GUIDE

The figure shows the number of mountainous areas that Pikas lived in 1990 and 2010. It also shows a prediction for 2090. By creating a line graph based on the numbers and answering related questions, students strengthen skills in data analysis. This activity was created based on data obtained from the National Wildlife Federation and the Scientific American Journal.

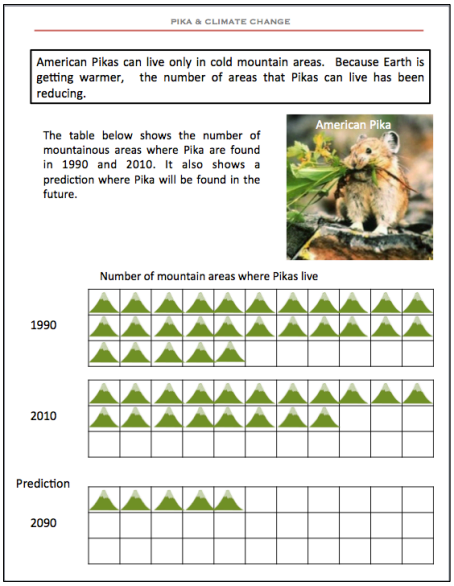
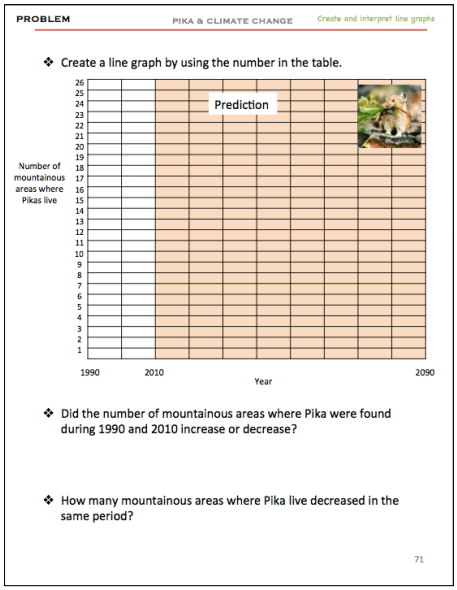


Table (Page 70)

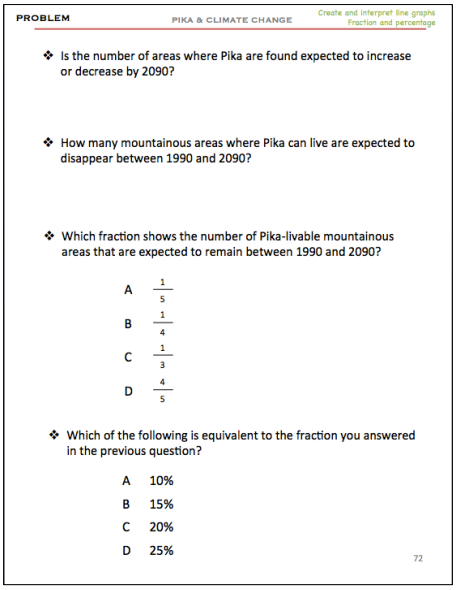
PROBLEM

- *Line graphs*
- *Fractions and percentages*

Students are asked to create a line graph, using numbers in the table. Students are also asked to find out a fraction and a percentage that show the number of habitable areas that will disappear by 2090.



P 71—Student Sheet



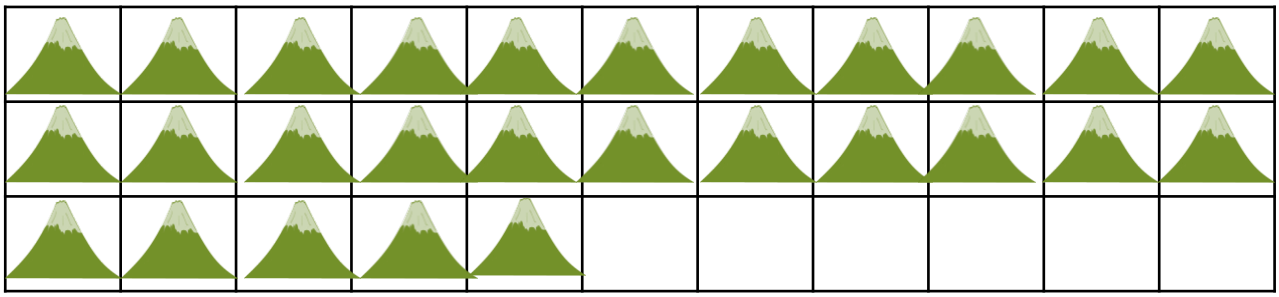
P 72—Student Sheet

American Pikas can live only in cold mountain areas. Because Earth is getting warmer, the number of areas that Pikas can live has been reducing.

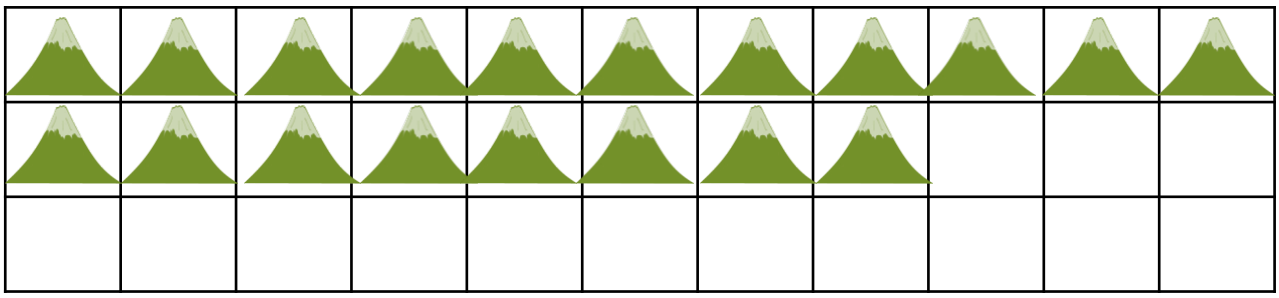
The table below shows the number of mountainous areas where Pika are found in 1990 and 2010. It also shows a prediction where Pika will be found in the future.

Number of mountain areas where Pikas live

1990

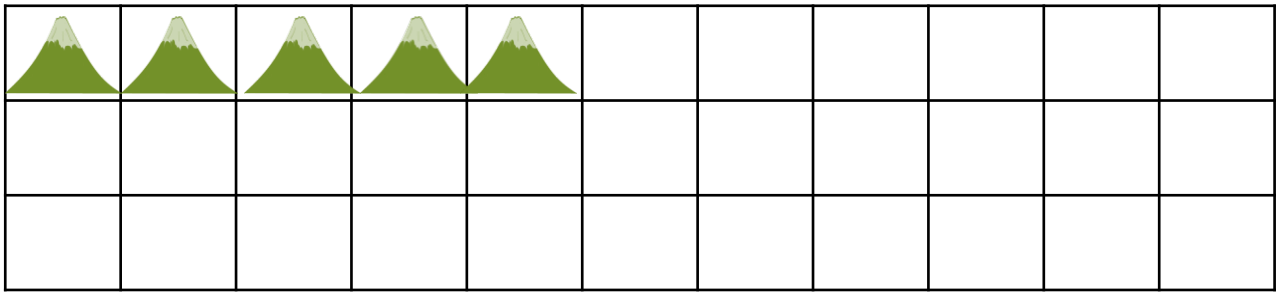


2010

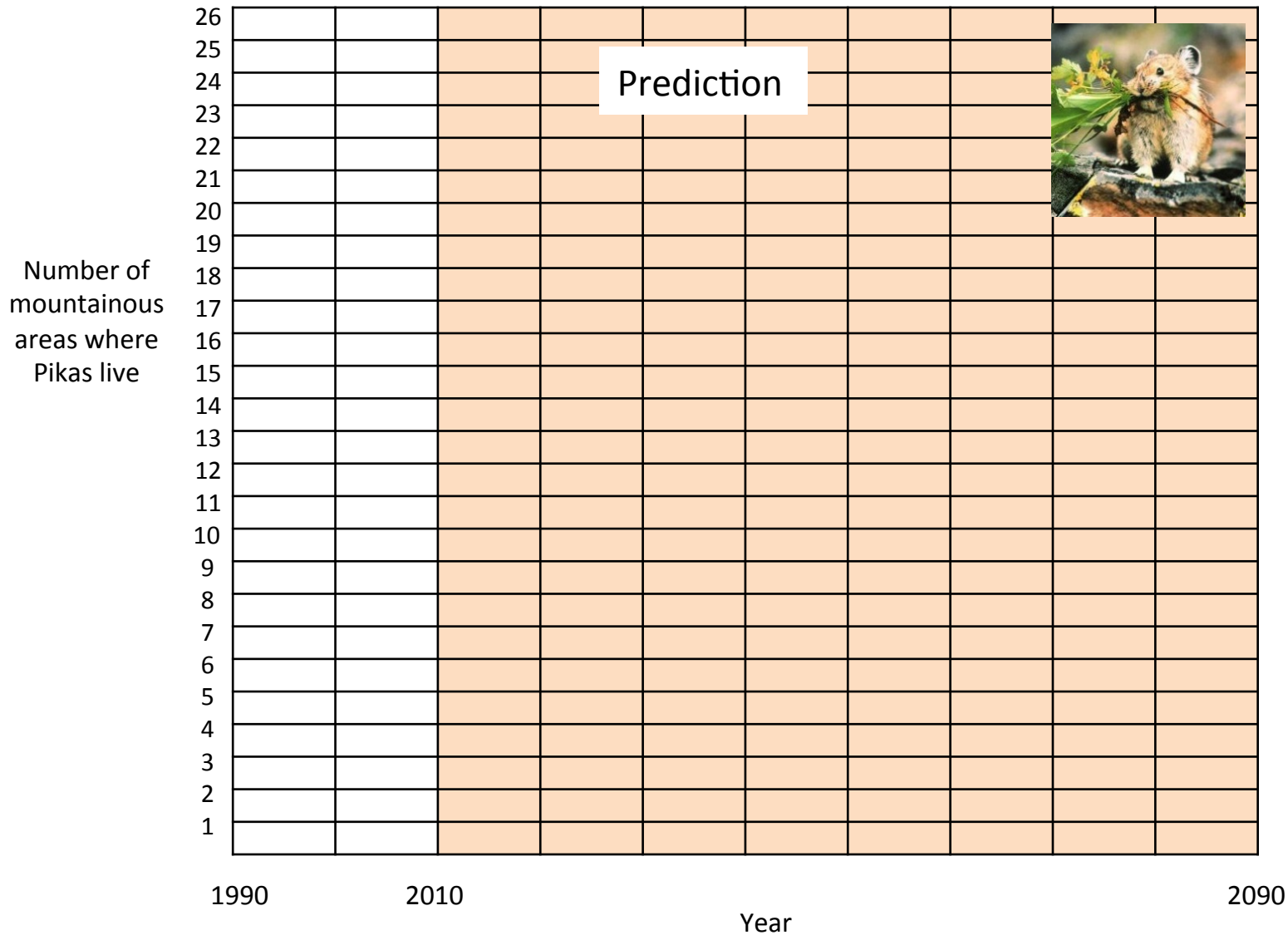


Prediction

2090



❖ Create a line graph by using the number in the table.



❖ Did the number of mountainous areas where Pika were found during 1990 and 2010 increase or decrease?

❖ How many mountainous areas where Pika live decreased in the same period?

- Is the number of areas where Pika are found expected to increase or decrease by 2090?

- How many mountainous areas where Pika can live are expected to disappear between 1990 and 2090?

- Which fraction shows the number of Pika-livable mountainous areas that are expected to remain between 1990 and 2090?

A $\frac{1}{5}$

B $\frac{1}{4}$

C $\frac{1}{3}$

D $\frac{4}{5}$

- Which of the following is equivalent to the fraction you answered in the previous question?

A 10%

B 15%

C 20%

D 25%

PROBLEM 10

Measurement

G3
G4

Inch & Foot

HOW MUCH DOES SEA LEVEL RISE?

PURPOSE

Through this activity, **3rd -4th grade** students will

- Identify a tool to measure length
- Guess and measure length
- Convert from feet to inches
- Understand the effect of climate change on global sea level
- Develop awareness of climate change

BACKGROUND FOR THE TEACHER

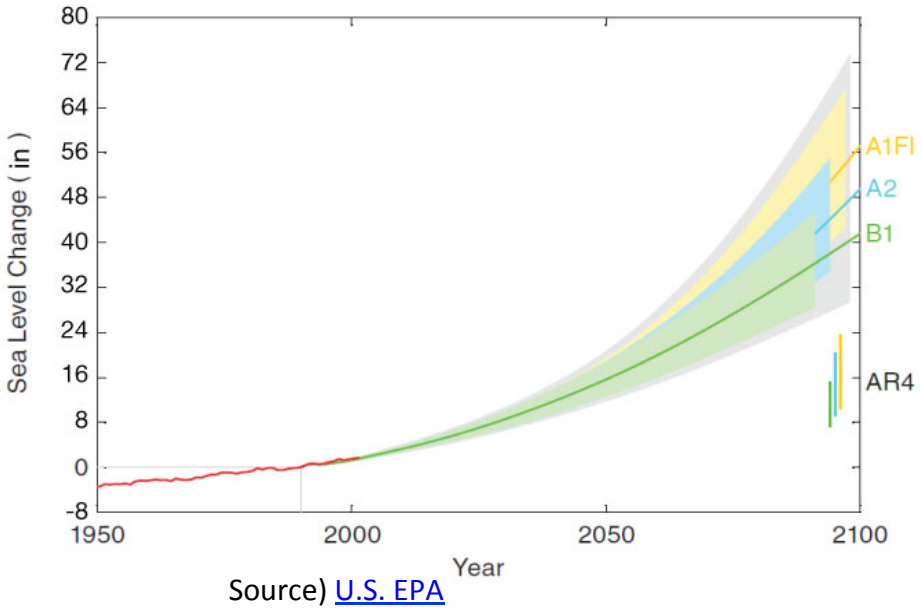
Scientific research indicates that over the past century, the global sea level has risen by between 4 and 8 inches. However, the current annual rate is roughly twice average speed of a century ago.

One of the main reasons of the sea level rise is expansion of greenhouse gas emissions that has increased the Earth's surface and ocean temperatures. When water in the ocean heats up, it makes the volume of water expand, resulting in sea level rise. Sea ice has already displaced volume, so sea ice melt will not directly raise the water level.

Melting of glaciers and polar ice caps is another contributing factor to global sea level rise. Greenland lost 36 to 60 cubic miles of ice per year between 2002 and 2006, while Antarctica lost about 36 cubic miles of ice between 2002 and 2005 (NASA-b) It has been predicted that, under the worst scenario, global sea level will rise by 56 inches by 2100. Sea level rise is a threat to people who live in coastal areas. It can also damage coastal ecosystems including coral reefs and mangrove forests.

TEACHER GUIDE

This activity uses numbers that global sea level has risen by 8 inches over the last 150 years and will rise by 4 feet by 2100. Students strengthen skills in measurement through answering questions related to length.

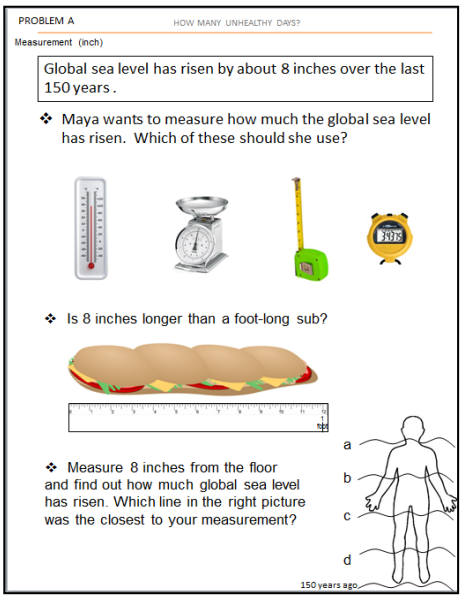


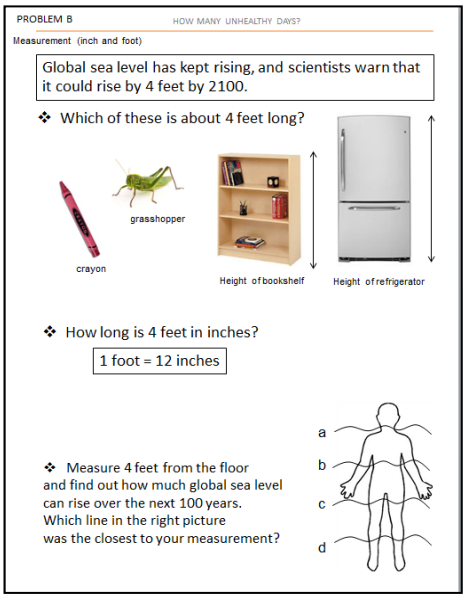
Source) U.S. EPA

PROBLEM A & B

- *Measurement (Inch & Feet)*

Students are asked to find a tool to measure length. Students are also asked to guess and measure how long 8 inches/4 feet is. A problem that asks to convert from feet to inches is also provided in PROBLEM B.



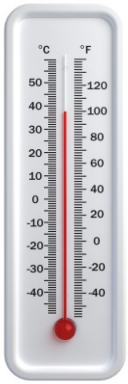


PROBLEM A: P 75—Student Sheet

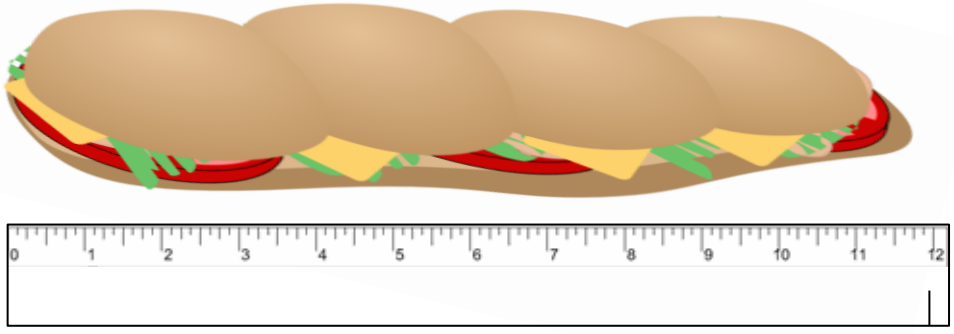
PROBLEM B: P 76—Student Sheet

Global sea level has risen by about 8 inches over the last 150 years.

- Maya wants to measure how much the global sea level has risen. Which of these should she use?

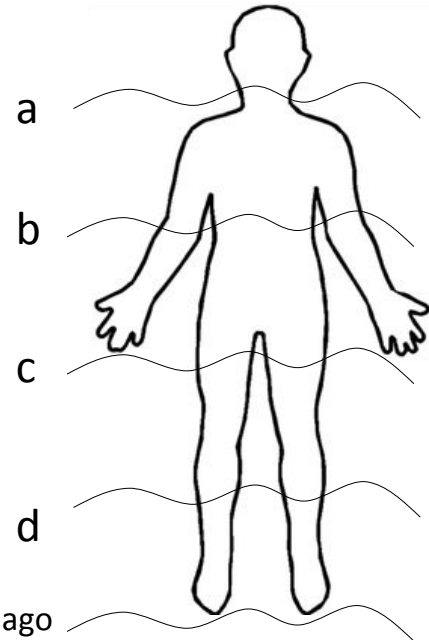


- Is 8 inches longer than a foot-long sub?



1 foot

- Measure 8 inches from the floor and find out how much global sea level has risen. Which line on the picture on the right was the closest to your measurement?



Global sea level has kept rising, and scientists warn that it could rise by 4 feet by 2100.

❖ Which of these is about 4 feet long?

crayon

grasshopper

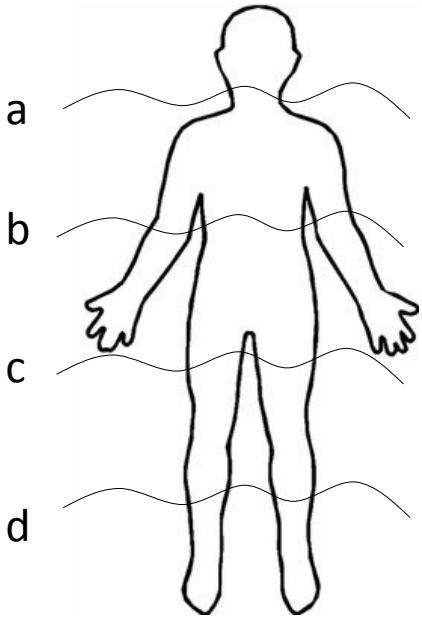
Height of bookshelf

Height of refrigerator

❖ How long is 4 feet in inches?

1 foot = 12 inches

❖ Measure 4 feet from the floor and find out how much global sea level could rise over the next 100 years. Which line in the picture on the right was the closest to your measurement?



PROBLEM 11

Number and operations

G3 Subtraction
G4 (3 digits)

Data Analysis

G4 Line graphs
G5 (3 digits)

THE HOTTEST & COLDEST DAYS

PURPOSE

Through this activity, **3rd -4th grade** students will

- Subtract 3-digit numbers--**PROBLEM A**
- Understand the hottest and coldest days of 2011-13 in Evansville
- Develop awareness of climate change

Through this activity, **4 -5th grade** students will

- Interpret a line graph (3-digit numbers) -**PROBLEM B**
- Interpret both a line graph and a table --**CHALLENGE**
- Understand the hottest and coldest days of 2011-13 in Evansville
- Understand average high and low temperature in Evansville
- Develop awareness of climate change

BACKGROUND FOR THE TEACHER

Rising global temperature has been accompanied by climate change—significant and long-lasting change in weather. Many places have already experienced climate change such as increased frequency of intense rains, floods, droughts, snow, and extreme heat and heat waves.

In 2012 alone, the United States experienced 3,527 weather records broken for heat, rain, and snow. In Indiana alone, broken records included 109 heat records, 10 snowfall records, and 9 precipitation records. Vanderburgh County experienced two broken heat records and one broken snow record in 2012.

TEACHER GUIDE

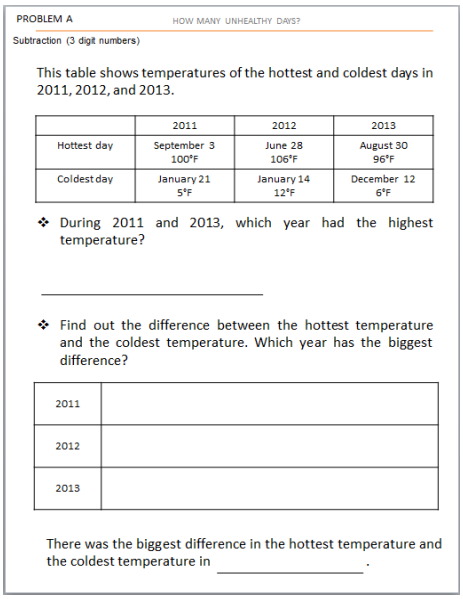
The purpose of this activity is to improve subtraction and data analysis skills while learning about the hottest, coldest, and average temperature for the years 2011-2013 in Evansville. The table represents the temperature of the hottest days and coldest days in 2011, 2012, and 2013 in Evansville.

This activity was created based on data obtained from Weatherspark.

PROBLEM A

- *Subtraction (3-digit numbers)*

Using the numbers in the table that show the hottest and coldest days of 2011 and 2013 in Evansville, students are asked to compare those numbers to find out the largest (highest temperature) and the smallest number (lowest temperature). They also use subtraction to compute the difference between the hottest and coldest temperatures.



PROBLEM A HOW MANY UNHEALTHY DAYS?

Subtraction (3 digit numbers)

This table shows temperatures of the hottest and coldest days in 2011, 2012, and 2013.

	2011	2012	2013
Hottest day	September 3 100°F	June 28 106°F	August 30 96°F
Coldest day	January 21 5°F	January 14 12°F	December 12 6°F

❖ During 2011 and 2013, which year had the highest temperature?

_____

❖ Find out the difference between the hottest temperature and the coldest temperature. Which year has the biggest difference?

2011	
2012	
2013	

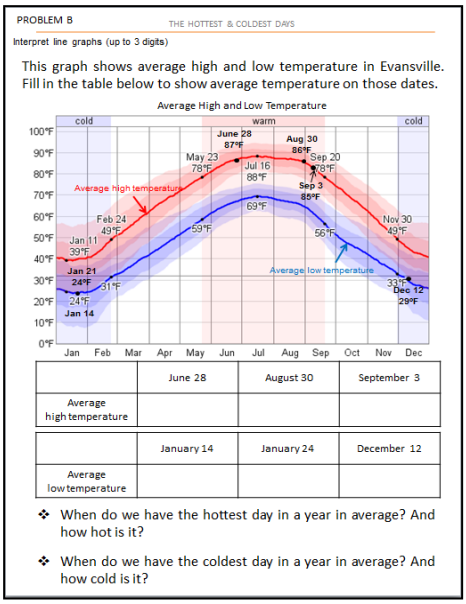
There was the biggest difference in the hottest temperature and the coldest temperature in _____.

P 80—Student Sheet

PROBLEM B

- *Line graphs (up to 3 digits)*

Using the line graph that represents average high and low temperatures in Evansville, students are asked to find the average temperatures on six days. Students are also asked to point out the hottest/coldest day on average in this area.


PROBLEM B

THE HOTTEST & COLDEST DAYS

Interpret line graphs (up to 3 digits)

This graph shows average high and low temperature in Evansville. Fill in the table below to show average temperature on those dates.

Average High and Low Temperature

cold warm cold

100°F 90°F 80°F 70°F 60°F 50°F 40°F 30°F 20°F 10°F 0°F

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

June 28 87°F; Aug 30 86°F; May 23 78°F; Jul 16 88°F; Sep 20 78°F; Sep 3 85°F; Feb 24 49°F; Jan 11 39°F; Jan 21 24°F; 31°F; 24°F; Jan 14; 69°F; 59°F; 56°F; Nov 30 49°F; 33°F; Dec 12 29°F

Average high temperature

Average low temperature

	June 28	August 30	September 3
Average high temperature			

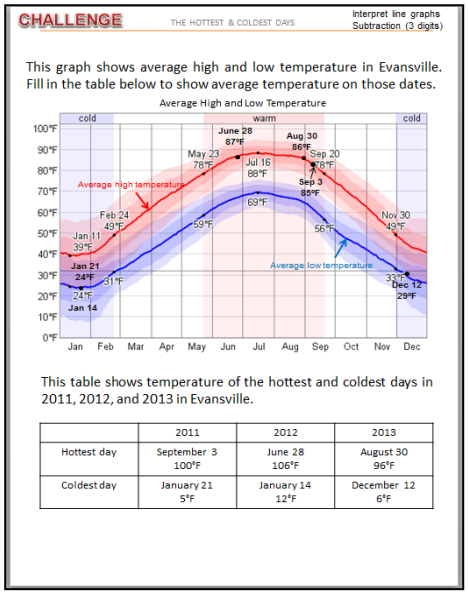
	January 14	January 24	December 12
Average low temperature			

- When do we have the hottest day in a year in average? And how hot is it?
- When do we have the coldest day in a year in average? And how cold is it?

P 81—Student Sheet

CHALLENGE

This page is designed for those who would like to solve a more challenging problem. Using both the table and line graph, students use subtraction to find out how much hotter/colder the hottest/coldest day of the year was in comparison to the average temperature.


CHALLENGE THE HOTTEST & COLDEST DAYS Interpret line graphs Subtraction (3 digits)

This graph shows average high and low temperature in Evansville. Fill in the table below to show average temperature on those dates.

Average High and Low Temperature

cold warm cold

100°F 90°F 80°F 70°F 60°F 50°F 40°F 30°F 20°F 10°F 0°F

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

June 28 87°F; Aug 30 86°F; May 23 78°F; Jul 16 88°F; Sep 20 78°F; Sep 3 85°F; Feb 24 49°F; Jan 11 39°F; Jan 21 24°F; 31°F; 24°F; Jan 14; 69°F; 59°F; 56°F; Nov 30 49°F; 33°F; Dec 12 29°F

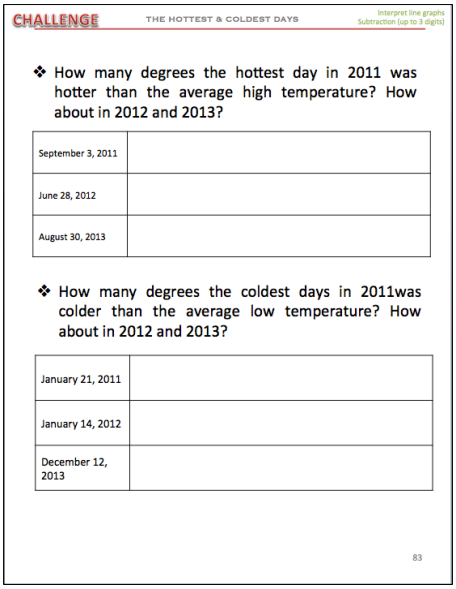
Average high temperature

Average low temperature

This table shows temperature of the hottest and coldest days in 2011, 2012, and 2013 in Evansville.

	2011	2012	2013
Hottest day	September 3 100°F	June 28 106°F	August 30 96°F
Coldest day	January 21 5°F	January 14 12°F	December 12 6°F

P 82—Student Sheet


CHALLENGE THE HOTTEST & COLDEST DAYS Interpret line graphs Subtraction (up to 3 digits)

- How many degrees the hottest day in 2011 was hotter than the average high temperature? How about in 2012 and 2013?

September 3, 2011	
June 28, 2012	
August 30, 2013	

- How many degrees the coldest days in 2011was colder than the average low temperature? How about in 2012 and 2013?

January 21, 2011	
January 14, 2012	
December 12, 2013	

83

P 83—Student Sheet

This table shows the temperature of the hottest and coldest days in 2011, 2012, and 2013 in Evansville.

	2011	2012	2013
Hottest day	September 3 100°F	June 28 106°F	August 30 96°F
Coldest day	January 21 5°F	January 14 12°F	December 12 6°F

❖ which year had the highest temperature, 2011, 2012 or 2013?

_____

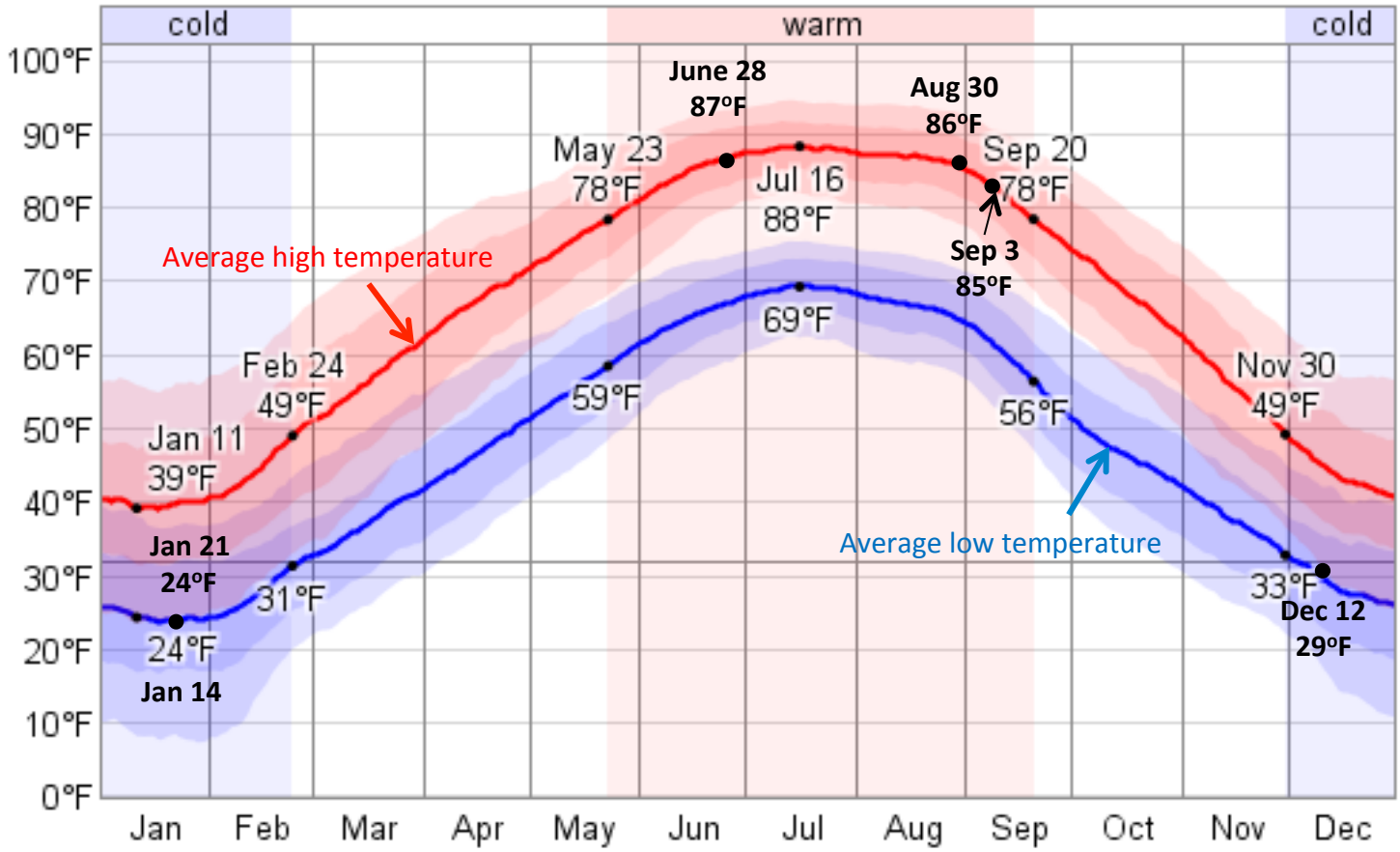
❖ Find the difference between the hottest temperature and the coldest temperature. Which year had the biggest difference?

2011	
2012	
2013	

The biggest difference in the hottest temperature and the coldest temperature was in the year _____ .

This graph shows average high and low temperature in Evansville. Fill in the table below to show average temperature on those dates.

Average High and Low Temperature



	June 28	August 30	September 3
Average high temperature			

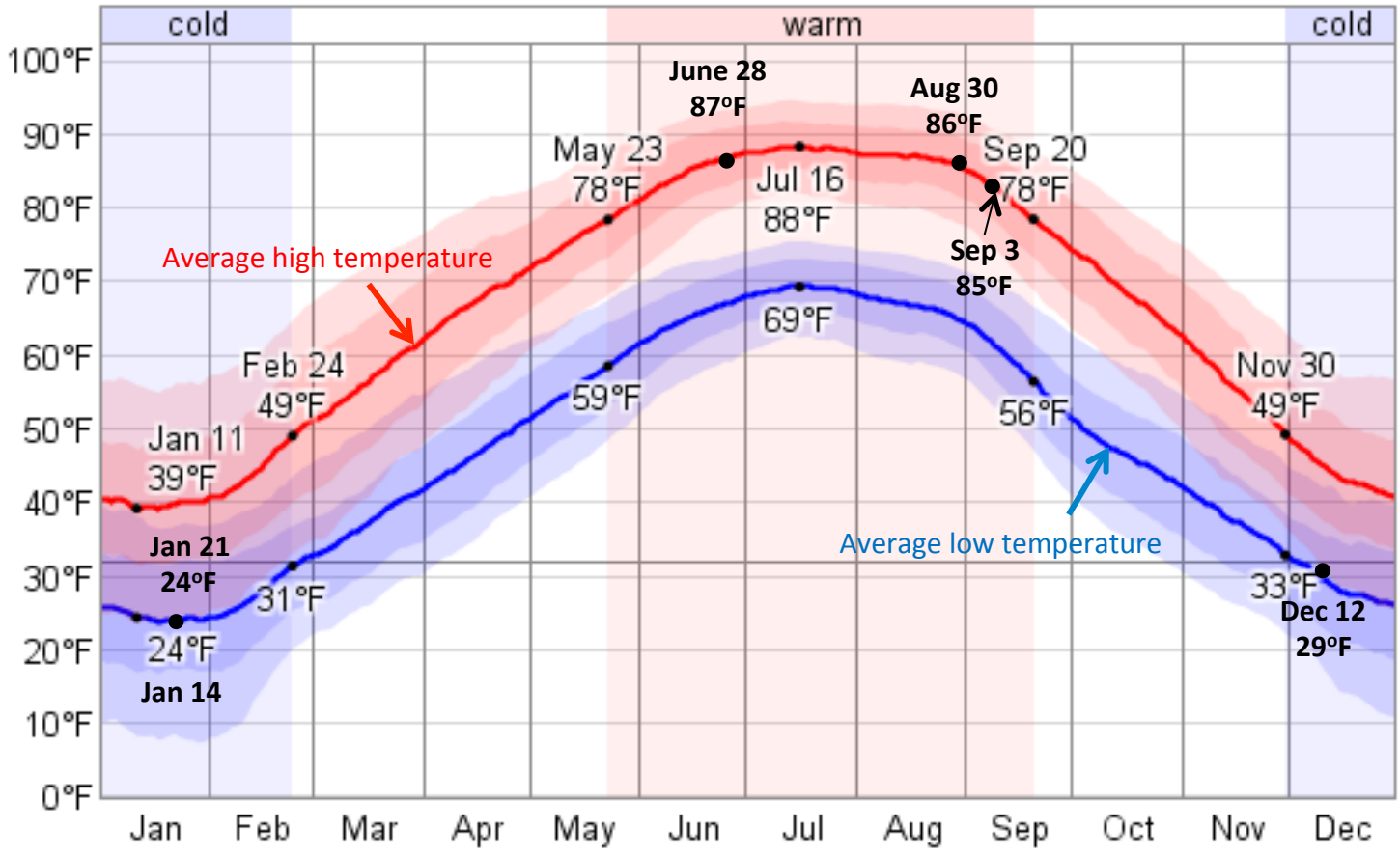
	January 14	January 24	December 12
Average low temperature			

- When do we have the hottest day of the year on average? And how hot is it?

- When do we have the coldest day of the year on average? And how cold is it?

This graph shows average high and low temperature in Evansville. Fill in the table below to show average temperature on those dates.

Average High and Low Temperature



This table shows temperature of the hottest and coldest days in 2011, 2012, and 2013 in Evansville.

	2011	2012	2013
Hottest day	September 3 100°F	June 28 106°F	August 30 96°F
Coldest day	January 21 5°F	January 14 12°F	December 12 6°F

❖ How many degrees the hottest day in 2011 was hotter than the average high temperature? How about in 2012 and 2013?

September 3, 2011	
June 28, 2012	
August 30, 2013	

❖ How many degrees the coldest days in 2011was colder than the average low temperature? How about in 2012 and 2013?

January 21, 2011	
January 14, 2012	
December 12, 2013	

PROBLEM 12

Data Analysis

G2
G3
G4

Bar graph
(up to 10)

WHAT MAKES HARMFUL GAS?

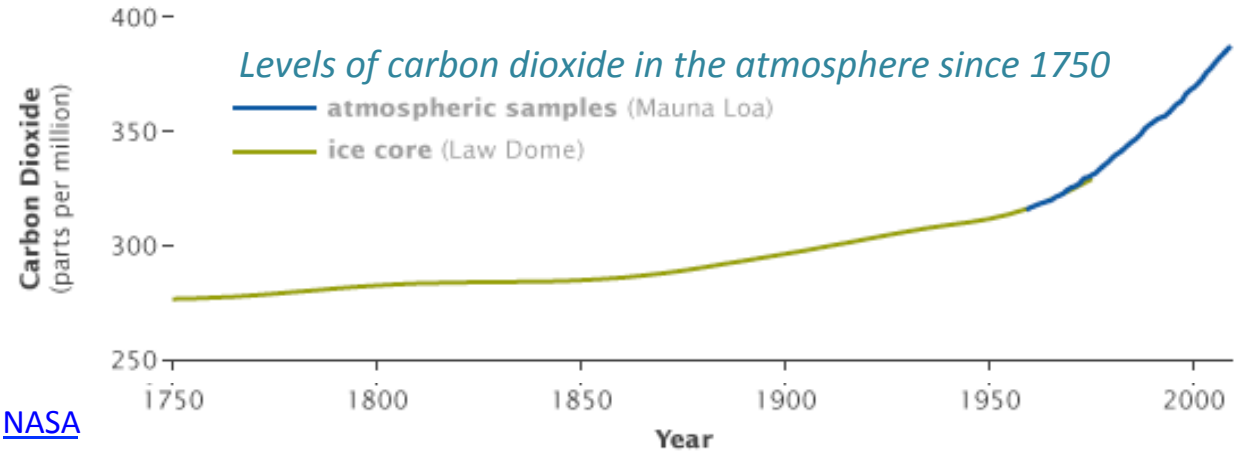
PURPOSE

Through this activity, **2nd -4th grade** students will

- Create and interpret a bar graph
- Gain an idea that most of household activities are associated with carbon dioxide emissions and climate change
- Develop awareness of climate change

BACKGROUND FOR THE TEACHER

Climate scientists point out that the increased amount of greenhouse gas emissions in the atmosphere has led to climate change. A study from NASA showed that, since the Industrial Revolution began in about 1750, carbon dioxide, one of the major greenhouse gases, increased by 38%, while methane, another major greenhouse gas, increased by 148%.



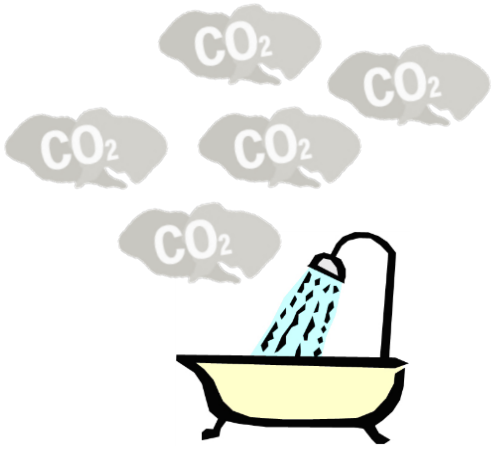
Source: NASA

Carbon dioxide can be produced from a variety of human activities, such as burning fossil fuels for energy generation, transportation, and heating buildings, cutting down carbon-absorbing forests for agriculture, and disposing of waste in landfills. Most of our daily activities such as watching TV, cooking, commuting to school, and taking a shower, are also associated with increasing the amount of carbon dioxide emissions in the atmosphere.

TEACHER GUIDE

The purpose of this activity is to improve students' skills in data analysis through creating and interpreting a bar graph while giving them the idea that many activities they do at home also contribute to carbon dioxide emissions and climate change. This activity is created based on data obtained from Reduce Carbon Footprint.

Playing video games
(1 hour a day)

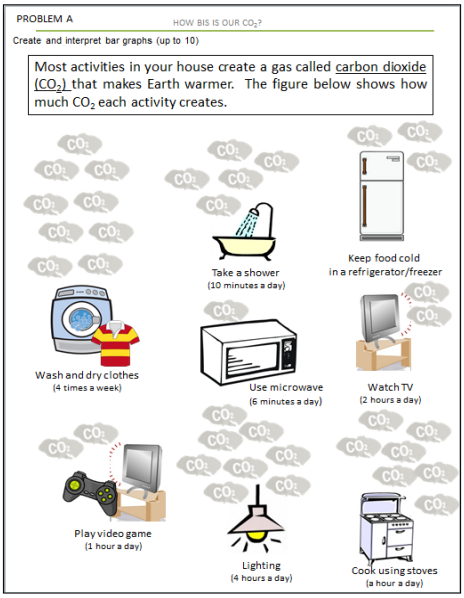


Taking a shower
(10 minutes a day)

PROBLEM

- *Bar graph (up to 10)*

This chart compares the amount of CO_2 emitted from typical household activities over a year. One CO2 represents 1 kilogram (kg) of CO_2/ year. Using this chart, students are asked to create a bar graph and arrange the activities in order starting with the one that creates most CO_2 in the house.


PROBLEM A HOW BIS IS OUR CO_2?

Create and interpret bar graphs (up to 10)

Most activities in your house create a gas called carbon dioxide (CO_2) that makes Earth warmer. The figure below shows how much CO_2 each activity creates.

Take a shower (10 minutes a day)

Keep food cold in a refrigerator/freezer

Wash and dry clothes (4 times a week)

Use microwave (6 minutes a day)

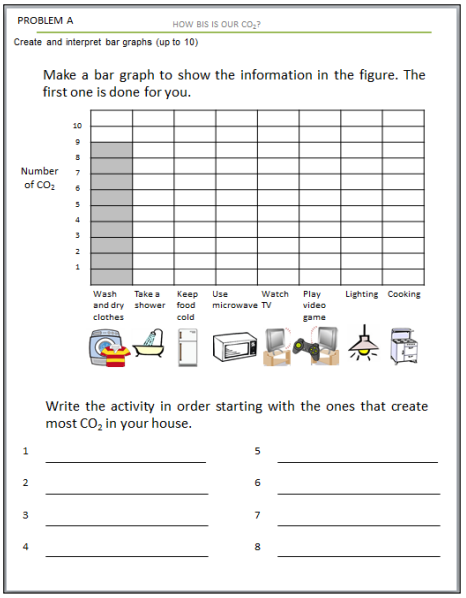
Watch TV (2 hours a day)

Play video game (1 hour a day)

Lighting (4 hours a day)

Cook using stoves (a hour a day)

P 86—Student Sheet


PROBLEM A HOW BIS IS OUR CO_2?

Create and interpret bar graphs (up to 10)

Make a bar graph to show the information in the figure. The first one is done for you.

Number of CO_2

Wash and dry clothes | Take a shower | Keep food cold | Use microwave | Watch TV | Play video game | Lighting | Cooking

Write the activity in order starting with the ones that create most CO_2 in your house.

1 _____ 5 _____

2 _____ 6 _____

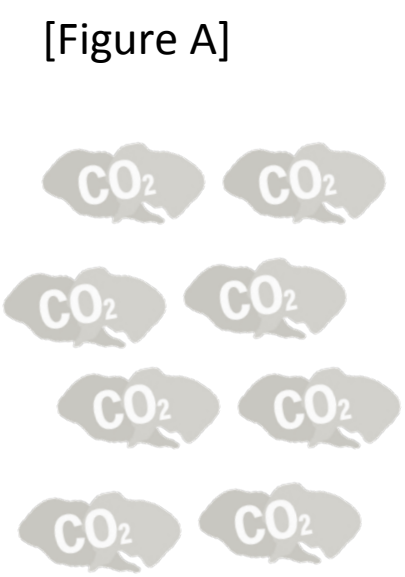
3 _____ 7 _____

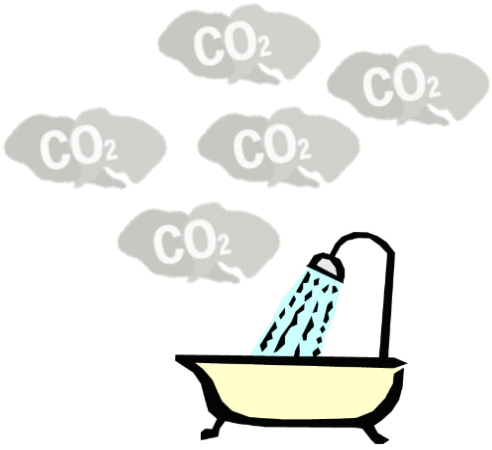
4 _____ 8 _____

P 87—Student Sheet

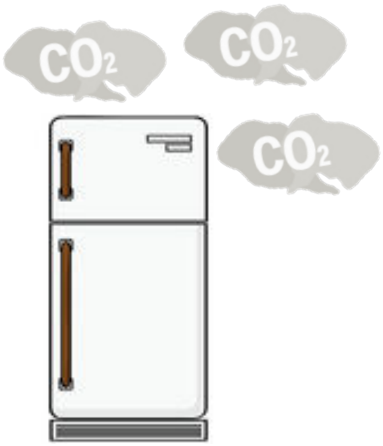
Most activities in your house create a gas called carbon dioxide (CO_2) that makes Earth warmer. The figure below (Figure A) shows how much CO_2 each activity creates.

[Figure A]



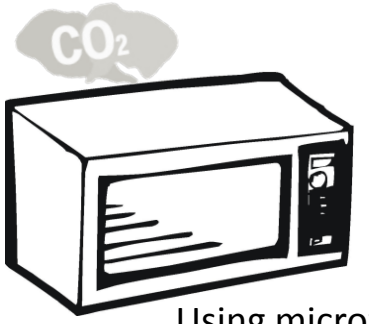


Taking a Shower
(10 minutes a day)



Keeping food cold
in a refrigerator/freezer

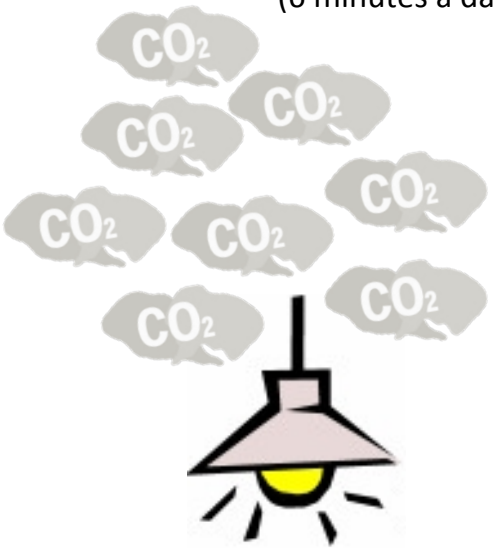
Washing and drying clothes
(4 times a week)



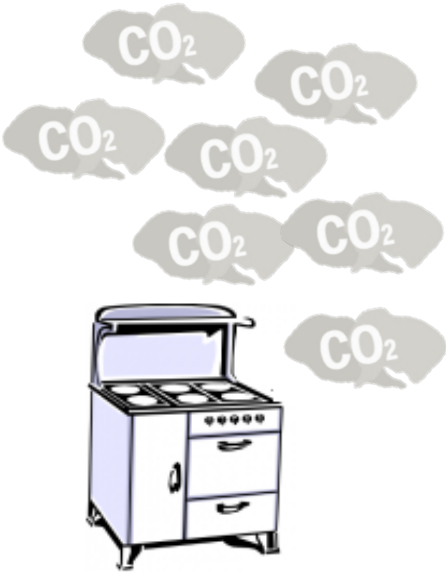
Using microwave
(6 minutes a day)

Watching TV
(2 hours a day)

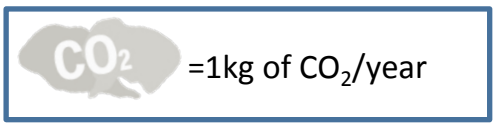
Playing video games
(1 hour a day)



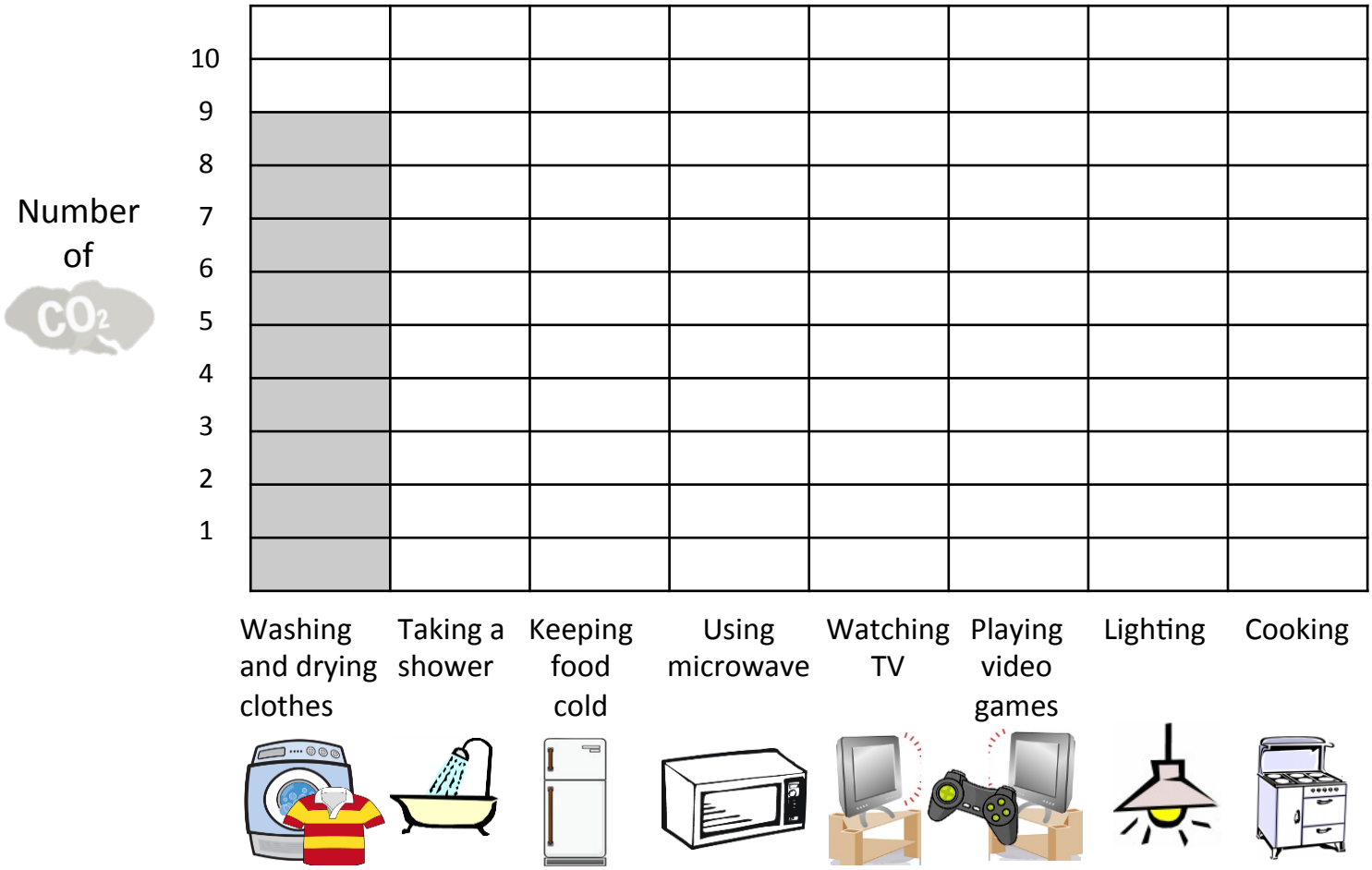
Lighting
(4 hours a day)



Using stoves
(1 hour a day)



Make a bar graph to represent the information in figure A. The first one is done for you.



Write the activities in order starting with the one that creates the most CO_2 in your house.

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

7 _____

8 _____

PROBLEM13

Data Analysis

G2 G3	Bar graphs (up to 11)
G3 G4	Circle graphs

Number & Operations

G4 G5	Percentages, decimals & fractions
G4 G5	Multiplication and division

WHO MAKES HARMFUL GAS?

PURPOSE

Through this activity, **2nd -3rd grade** students will

- Create and interpret bar graphs--**PROBLEM A**
- Understand major sources of CO_2 emissions in Indiana
- Develop awareness of greenhouse gas emissions

Through this activity, **3rd -4th grade** students will

- Interpret circle graphs--**PROBLEM B**
- Understand major sources of CO_2 emissions in Indiana
- Develop awareness of greenhouse gas emissions

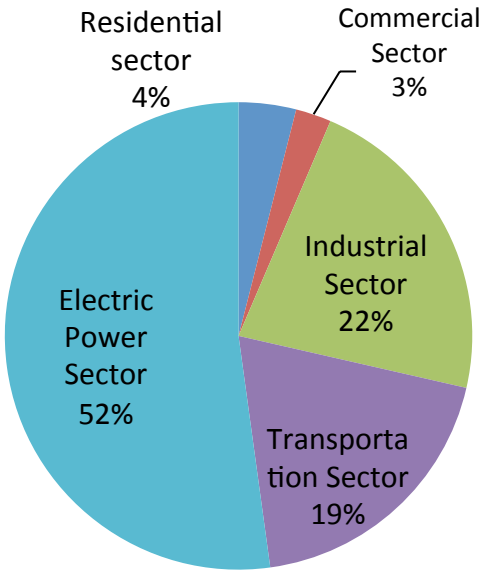
Through this activity, **4 -5th grade** students will

- Interpret circle graphs--**PROBLEM C**
- Convert from percentages to decimals and fractions--**PROBLEM C**
- Compute the actual amount of CO_2 emissions from each sector—**CHALLENGE**
- Develop awareness of greenhouse gas emissions

BACKGROUND FOR THE TEACHER

It has been identified that the increase of the concentration of greenhouse gases in the atmosphere has contributed to many changes such as warmer average temperature on Earth, climate change, and sea level rise. Carbon dioxide (CO_2) makes up the largest portion of greenhouse gases in our nation, about 84%, created by human activities. Carbon dioxide can be produced from a variety of human activities, such as burning fossil fuels for energy generation, transportation, and heating buildings, cutting down carbon-absorbing forests for agriculture, and disposing of waste in landfills.

In Indiana, more than half of the CO_2 emissions come from the electric power sector that produces and supplies electricity.



Major sources of CO_2 emissions in Indiana (2010)

TEACHER GUIDE

The purpose of this activity is to improve students' skills in data analysis and number operations through interpreting graphs while giving them an idea who produces how much CO_2 in Indiana. This activity is created based on data obtained from the Energy Information Administration.

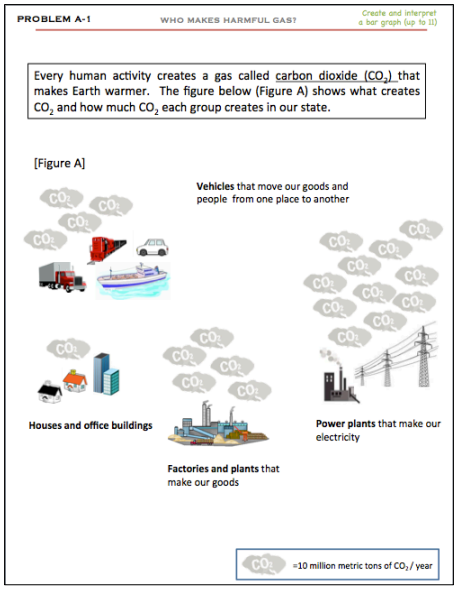
PROBLEM A

- *Bar graph (up to 11)*

This chart shows major sources of CO_2 emissions and compares the amount of CO_2 emissions from each sector in Indiana.

One CO_2 represents 10 million metric tons of CO_2 /year.

By using this chart, students are asked to create a bar graph and arrange the sector in order starting with the one that creates most CO_2 in this country.


PROBLEM A-1 WHO MAKES HARMFUL GAS? Create and interpret a bar graph (up to 11)

Every human activity creates a gas called carbon dioxide (CO_2) that makes Earth warmer. The figure below (Figure A) shows what creates CO_2 and how much CO_2 each group creates in our state.

[Figure A]

Vehicles that move our goods and people from one place to another

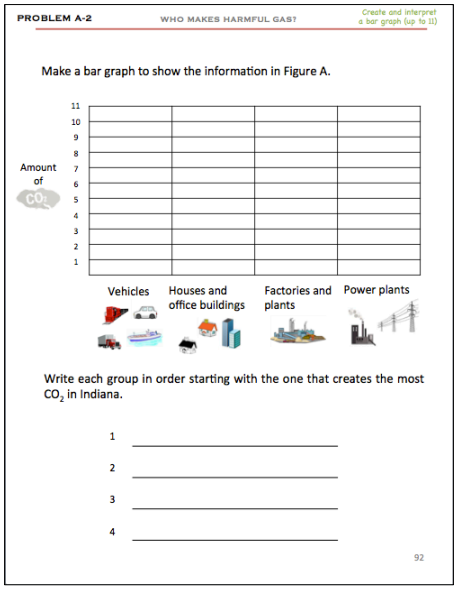
Houses and office buildings

Factories and plants that make our goods

Power plants that make our electricity

=10 million metric tons of CO_2 / year

P 91—Student Sheet


PROBLEM A-2 WHO MAKES HARMFUL GAS? Create and interpret a bar graph (up to 11)

Make a bar graph to show the information in Figure A.

Amount of CO_2

11 10 9 8 7 6 5 4 3 2 1

Vehicles | Houses and office buildings | Factories and plants | Power plants

Write each group in order starting with the one that creates the most CO_2 in Indiana.

1 _____
2 _____
3 _____
4 _____

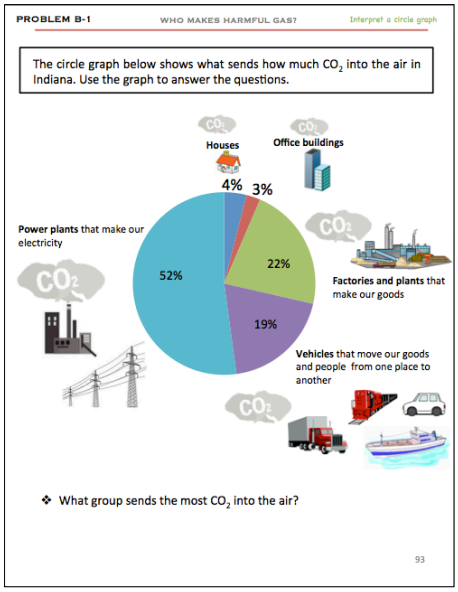
92

P 92—Student Sheet

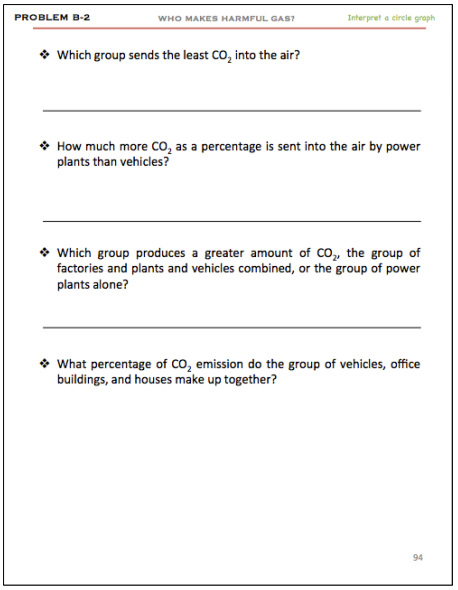
PROBLEM B

- *Circle graphs*

This circle graph shows major CO_2 emitting sources and each share in Indiana. By using this chart, students are asked to solve problems related to the graph, including a problem that asks the sector with the largest/least share.



P 93—Student Sheet

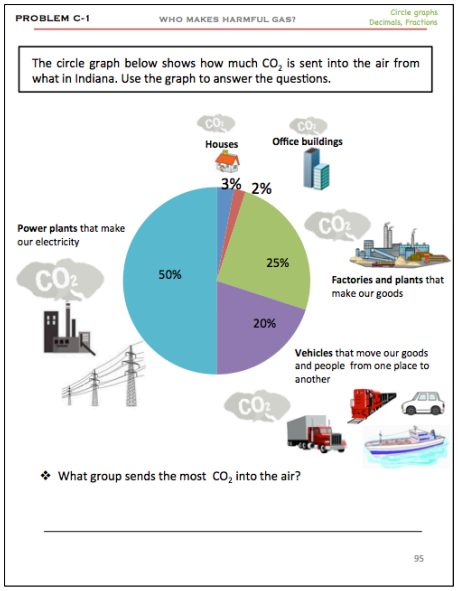


P 94—Student Sheet

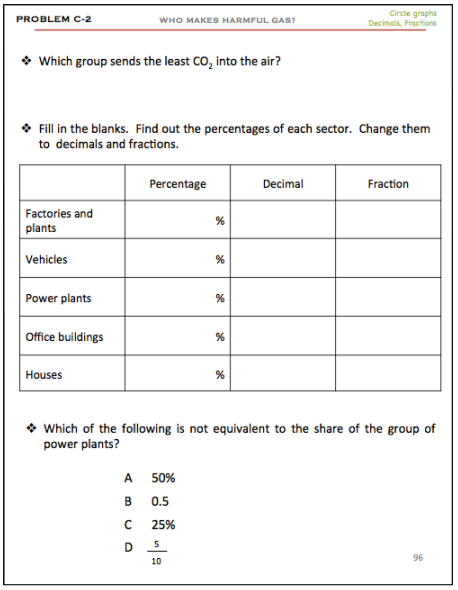
PROBLEM C

- *Circle graphs*
- *Percentages*
- *Decimals*
- *Fractions*

This circle graph shows major CO_2 emitting sources and percentage of each in Indiana. By using this chart, students are asked to convert from percentage to decimal and fraction.



P 95—Student Sheet

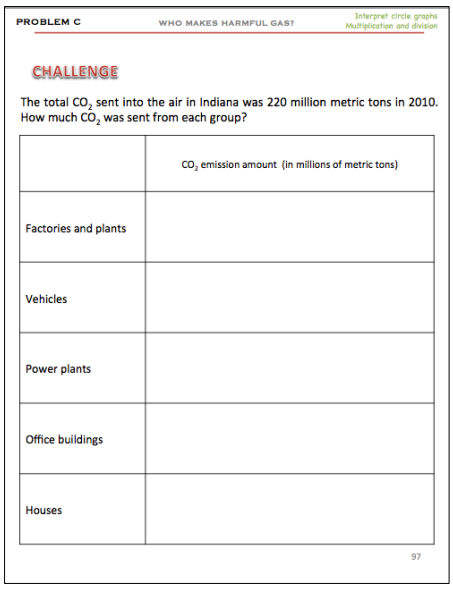


P 96—Student Sheet

CHALLENGE

- *Circle graphs*
- *Multiplication and division*

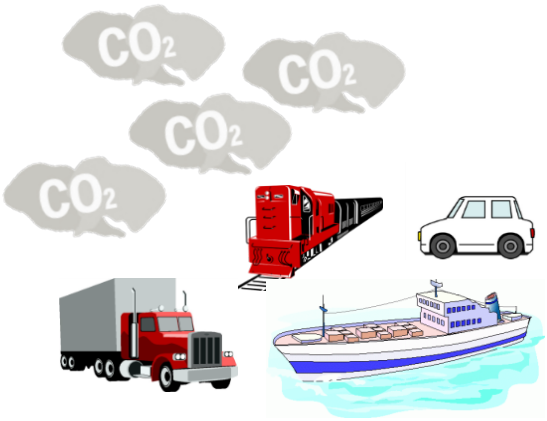
This page is designed for those who would like to solve a more challenging problem. Students are asked to find the actual amount of CO_2 emissions from each source.



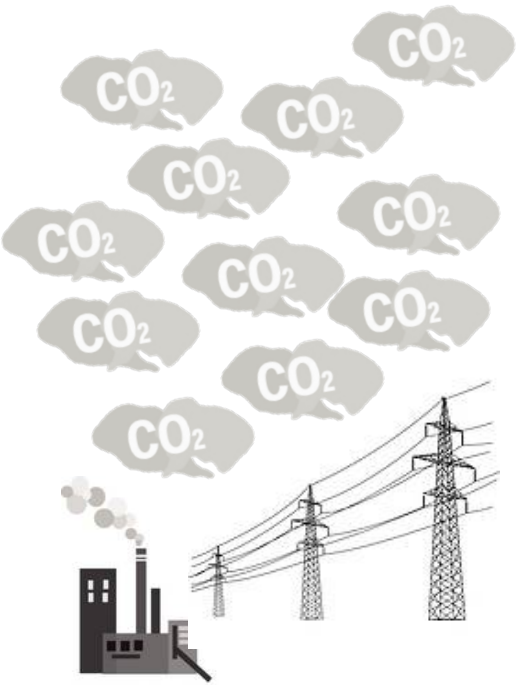
P 97—Student Sheet

Every human activity creates a gas called <u>carbon dioxide (CO_2)</u> that makes Earth warmer. The figure below (Figure A) shows what creates CO_2 and how much CO_2 each group creates in our state.

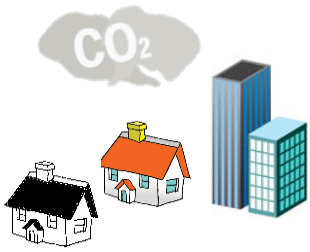
[Figure A]



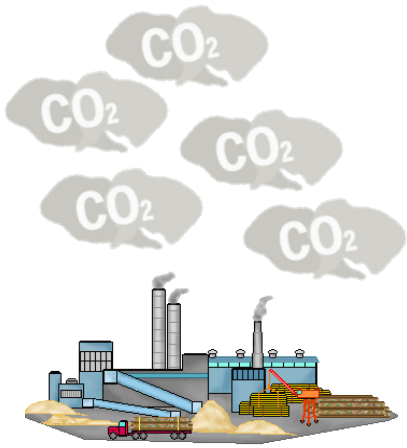
Vehicles that move our goods and people from one place to another



Power plants that make our electricity



Houses and office buildings



Factories and plants that make our goods

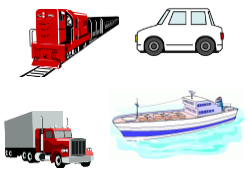
=10 million metric tons of CO_2 / year

Make a bar graph to show the information in Figure A.

Amount of CO_2

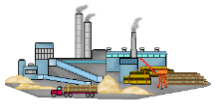
11
10
9
8
7
6
5
4
3
2
1

Vehicles

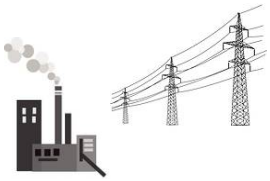


Houses and office buildings

Factories and plants



Power plants



Write each group in order starting with the one that creates the most CO_2 in Indiana.

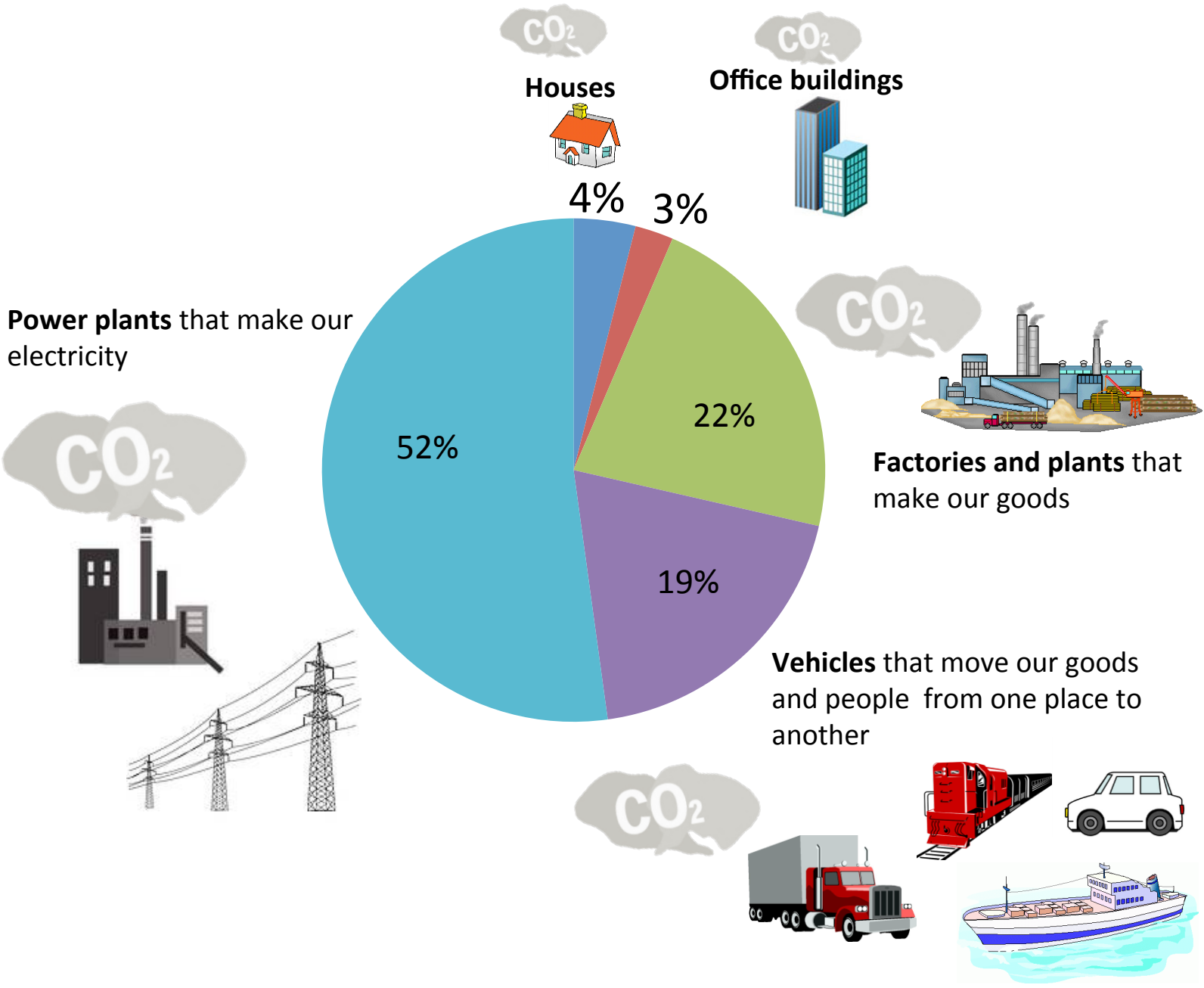
1 _____

2 _____

3 _____

4 _____

The circle graph below shows what sends how much CO_2 into the air in Indiana. Use the graph to answer the questions.



❖ What group sends the most CO_2 into the air?

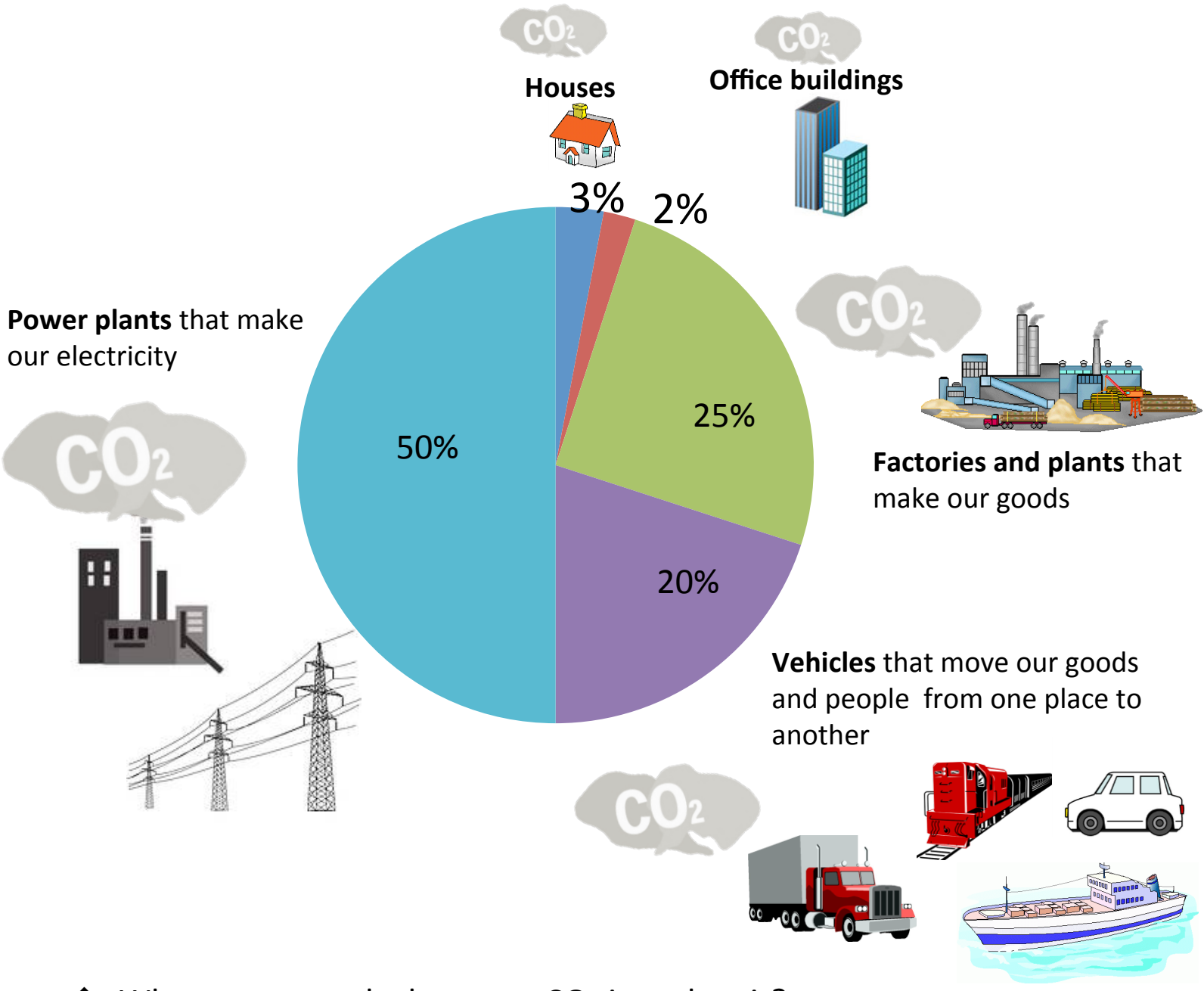
- Which group sends the least CO_2 into the air?

- How much more CO_2 as a percentage is sent into the air by power plants than vehicles?

- Which group produces a greater amount of CO_2, the group of factories and plants and vehicles combined, or the group of power plants alone?

- What percentage of CO_2 emission do the group of vehicles, office buildings, and houses make up together?

The circle graph below shows how much CO_2 is sent into the air from what in Indiana. Use the graph to answer the questions.



❖ What group sends the most CO_2 into the air?

❖ Which group sends the least CO_2 into the air?

❖ Fill in the blanks. Find out the percentages of each sector. Change them to decimals and fractions.

	Percentage	Decimal	Fraction
Factories and plants	%		
Vehicles	%		
Power plants	%		
Office buildings	%		
Houses	%		

❖ Which of the following is not equivalent to the share of the group of power plants?

A 50%

B 0.5

C 25%

D $\frac{5}{10}$

CHALLENGE

The total CO_2 sent into the air in Indiana was 220 million metric tons in 2010. How much CO_2 was sent from each group?

	CO_2 emission amount (in millions of metric tons)
Factories and plants	
Vehicles	
Power plants	
Office buildings	
Houses	

PROBLEM 14

Data Analysis

G3 Bar graphs
G4 (3 digits)

HOW BIG IS HARMFUL GAS?

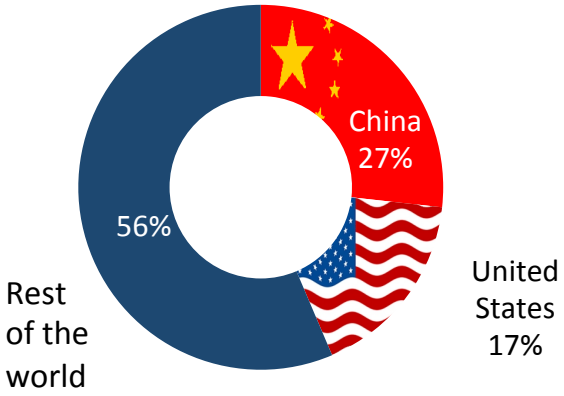
PURPOSE

Through this activity, **3rd -4th grade** students will

- Interpret bar graphs
- Improve skills on ordinal numbers
- Subtract 3-digit numbers
- Understand Indiana as the 8th highest CO_2 - emitting state in the United States—**PROBLEM A**
- Understand Indiana as the 3rd highest CO_2 - emitting state in the Midwestern United States-**PROBLEM B**
- Develop awareness of greenhouse gas emissions

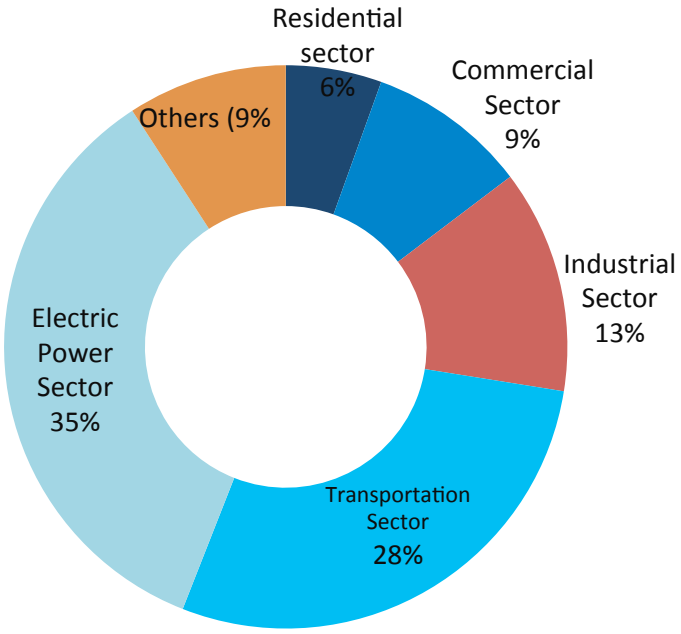
BACKGROUND FOR THE TEACHER

In 2011, the United States emitted 5.49 billion metric tons of CO_2. It ranked second in the world after China. China and our nation are the world's two largest CO_2 emitting countries, and both are responsible for 44% of the total CO_2 emissions in the world.

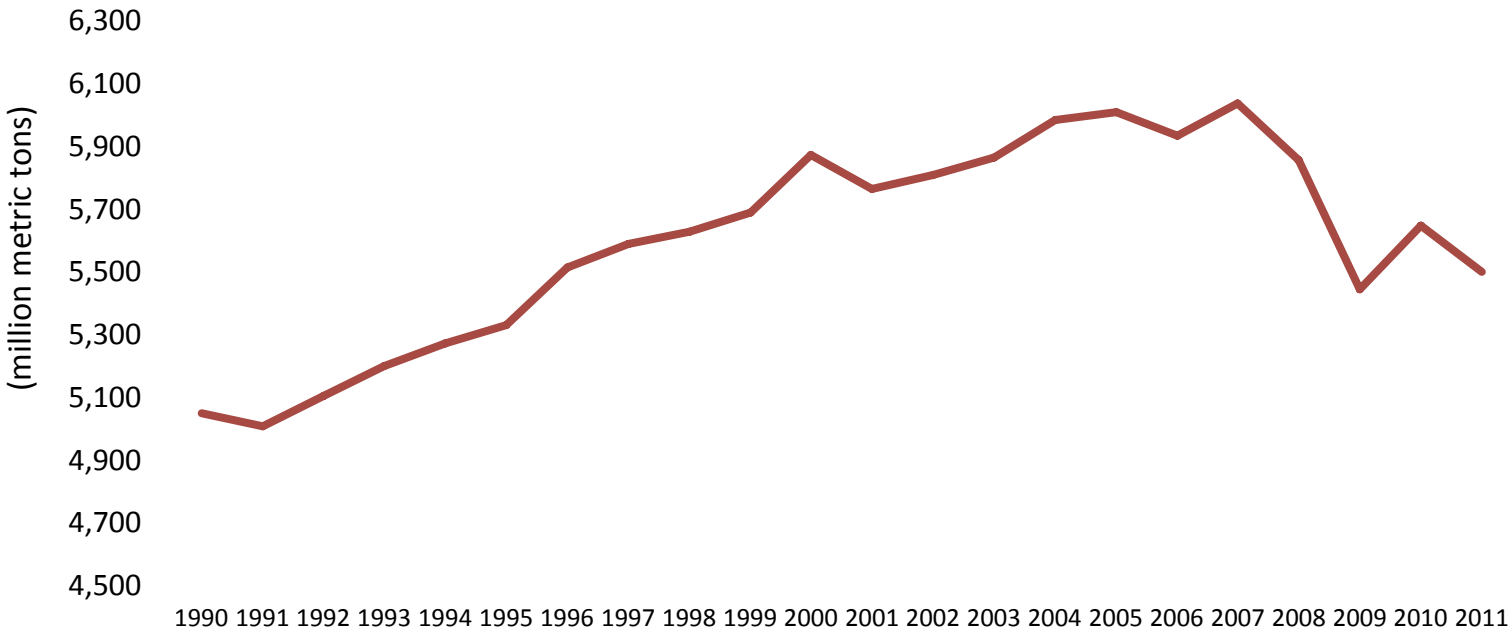


World CO_2 emissions by country

The amount of CO_2 emissions has increased in our country over the last 30 years due to the increase of fossil fuel combustion to meet our energy demands (see the line graph below). We saw a drop in 2009, attributable to the fact that energy consumption declined due to the economic recession that started in 2008. Transportation and electric power are the two major sources of CO_2 emissions in our nation (see the circle graph).



U.S. CO_2 emissions by source



CO_2 emission trend in the U.S.

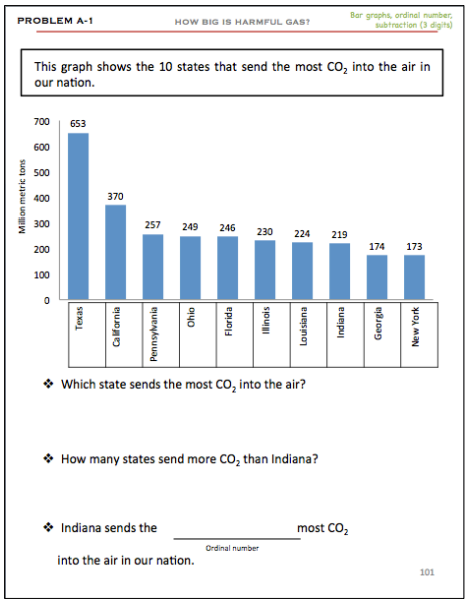
TEACHER GUIDE

The purpose of this activity is to improve students' skills in interpreting bar graphs by using graphs of 1) the 10 largest CO_2 - emitting states in our nation and 2) the amount of CO_2 emissions in 12 states of the Midwest. Through reading the graphs, students will get the idea that Indiana is one of the largest CO_2 - emitting states in the United States. Both graphs are created based on the data obtained from the U.S. Energy Information Administration.

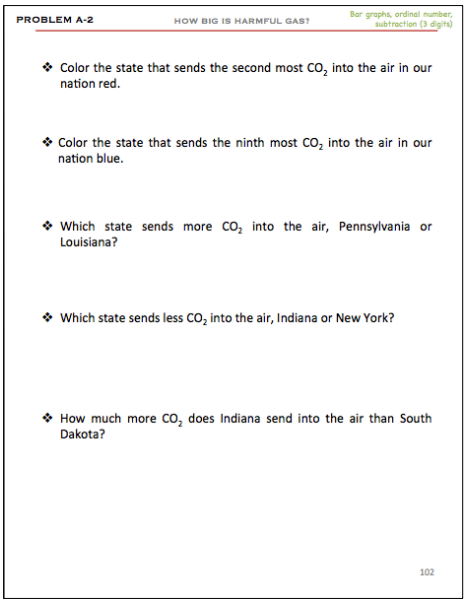
PROBLEM A

- *Bar graphs (3-digit numbers)*

This bar graphs shows the 10 largest CO_2- emitting states in our nation. Students are asked to solve questions related to the bar graph. Students will use ordinal numbers and subtraction to answer questions.



P 101—Student Sheet

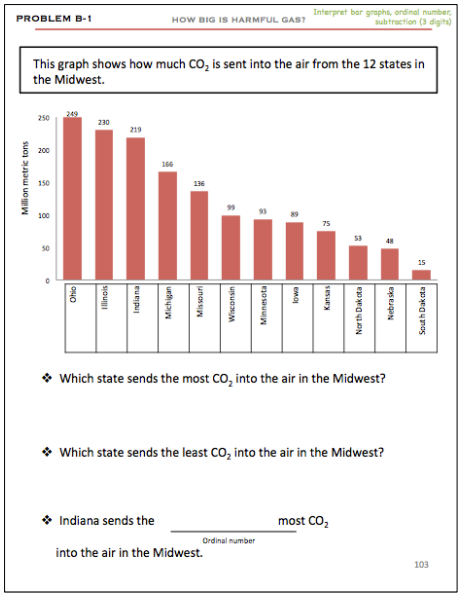


P 102—Student Sheet

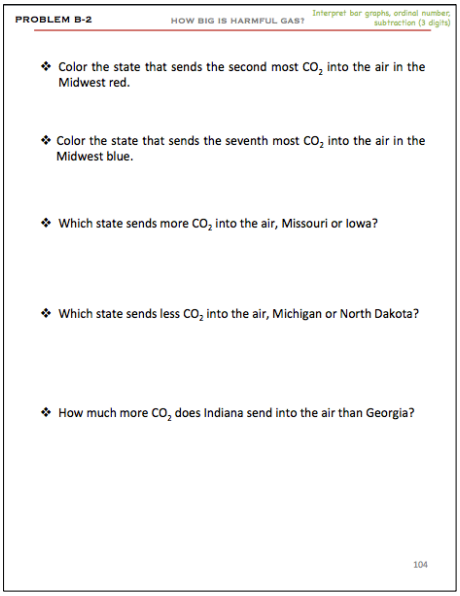
PROBLEM B

- *Bar graphs (3-digit numbers)*

This bar graphs shows the amount of CO2 emissions in 12 states in the Midwest. Students are asked to solve questions related to the bar graph. Students will use ordinal numbers and subtraction to answer questions.

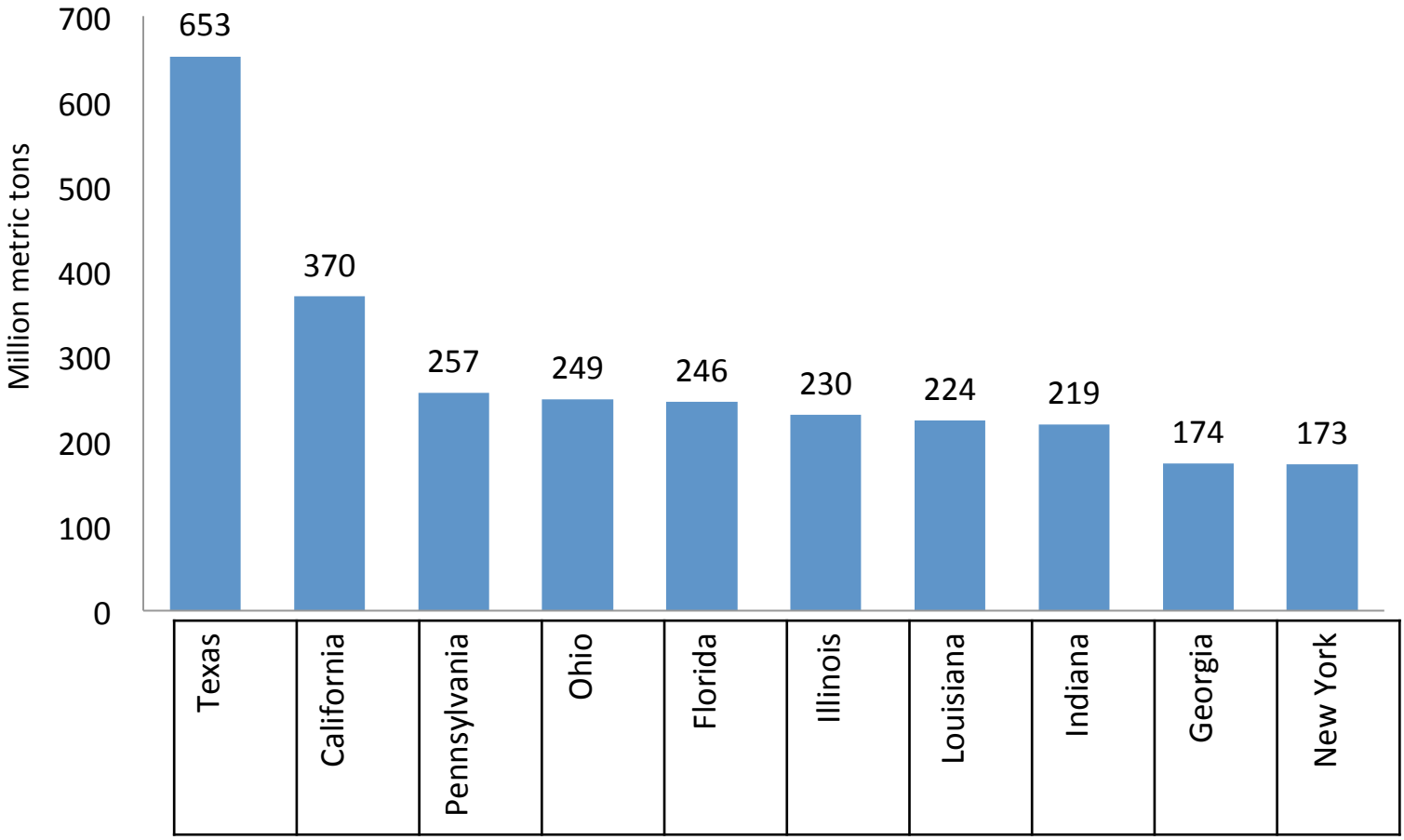


P 103—Student Sheet



P 104—Student Sheet

This graph shows the 10 states that send the most CO_2 into the air in our nation.



❖ Which state sends the most CO_2 into the air?

❖ How many states send more CO_2 than Indiana?

❖ Indiana sends the _____ most CO_2
Ordinal number

into the air in our nation.

- Color the state that sends the second most CO_2 into the air in our nation red.

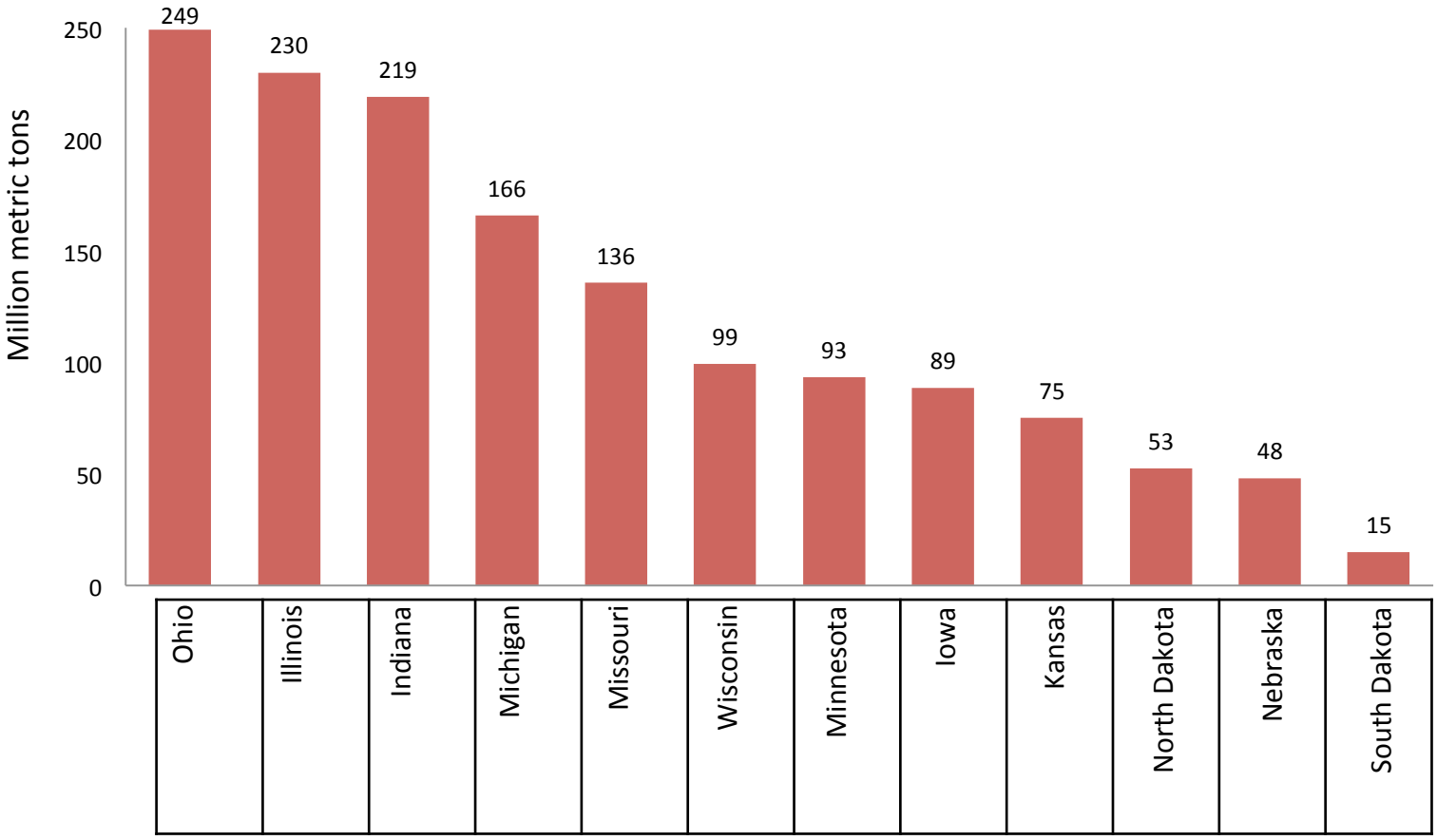
- Color the state that sends the ninth most CO_2 into the air in our nation blue.

- Which state sends more CO_2 into the air, Pennsylvania or Louisiana?

- Which state sends less CO_2 into the air, Indiana or New York?

- How much more CO_2 does Indiana send into the air than South Dakota?

This graph shows how much CO_2 is sent into the air from the 12 states in the Midwest.



❖ Which state sends the most CO_2 into the air in the Midwest?

❖ Which state sends the least CO_2 into the air in the Midwest?

❖ Indiana sends the _____ most CO_2
Ordinal number
into the air in the Midwest.

- Color the state that sends the second most CO_2 into the air in the Midwest red.

- Color the state that sends the seventh most CO_2 into the air in the Midwest blue.

- Which state sends more CO_2 into the air, Missouri or Iowa?

- Which state sends less CO_2 into the air, Michigan or North Dakota?

- How much more CO_2 does Indiana send into the air than Georgia?

PROBLEM 15

Data Analysis

G3
G4
G5

Line graphs
(3 digits)

DO WE MAKE MORE HARMFUL GAS OR LESS?

PURPOSE

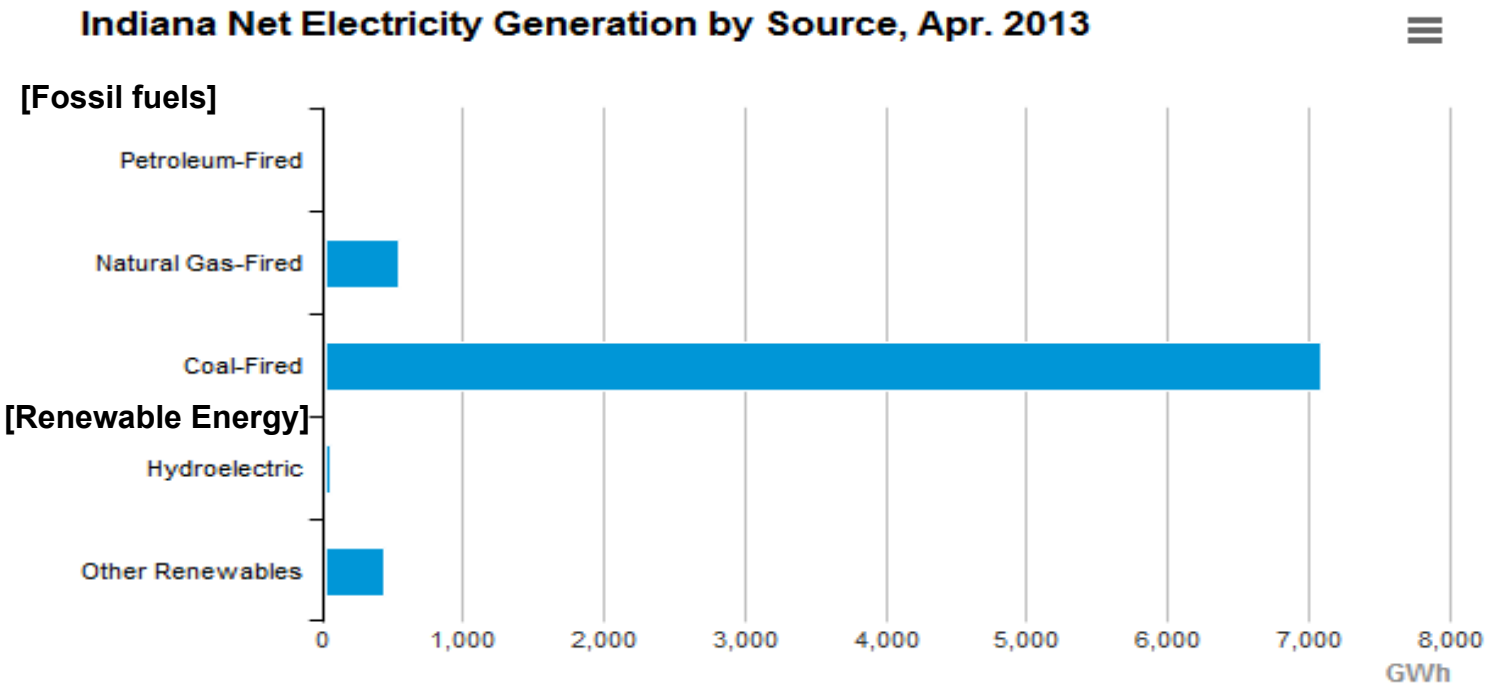
Through this activity, **3rd -5th grade** students will

- Interpret line graphs (3 digit-numbers)
- Compare 3 digit-numbers
- Understand trends in CO_2 emissions in Indiana over the last quarter century
- Develop awareness of greenhouse gas emissions

BACKGROUND FOR THE TEACHER

The amount of CO_2 emissions in Indiana has steadily increased since 1990, but declined in 2009 (see figure on page 108). Burning fossil fuels in the electric power sector to generate electricity has been responsible for more than half of the total CO_2 emissions in Indiana (see figure on page 93). One reason that CO_2 emissions from the electric power sector in our state accounts for a larger share than that of the United States is that our state depends primarily on coal for electricity production (see bar graph on page 106).

Among fossil fuels, coal produces the largest CO_2 when combusted, almost double the amount from natural gas (EIA). According to the U.S. Energy Information Administration, Indiana ranked 7th in coal production, and coal-fired electric power plants supply 83% of Indiana's net electricity. The percentage of coal in electricity production in the United States was 45% in 2010. Our state released 219 million metric tons of carbon and ranked seventh in the nation in 2010 (EIA).



Source: EIA

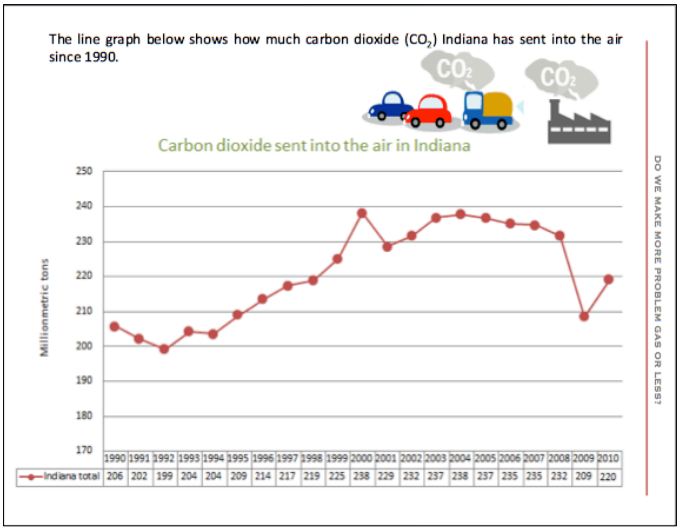
TEACHER GUIDE

The purpose of this activity is to improve students' skills in interpreting line graphs by using a graph that shows trends of CO_2 emissions in Indiana since 1990 . Through reading the graph, students will understand the idea that CO_2 emissions in their state has been increasing over the last quarter century.

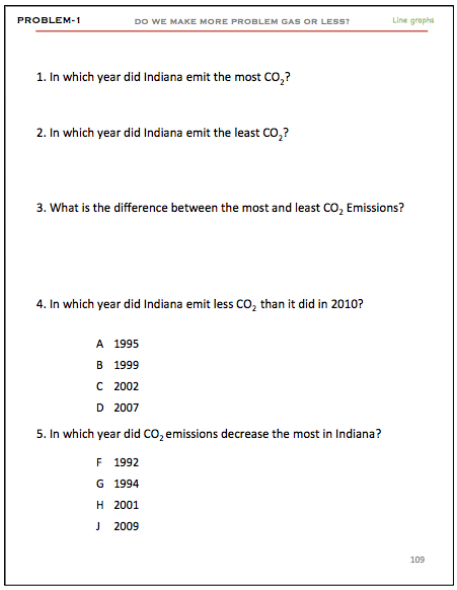
PROBLEM

- *Line graphs (3 digit-numbers)*

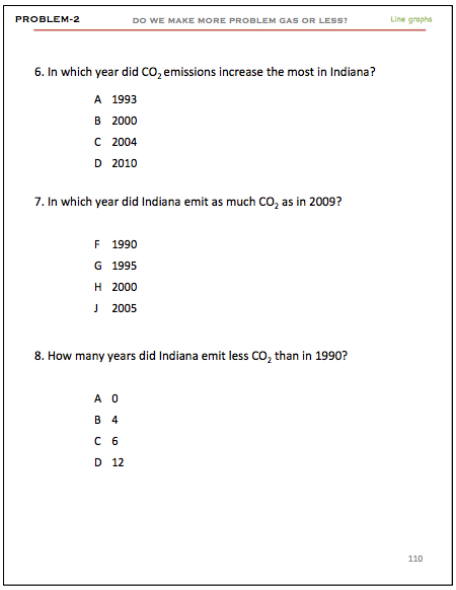
The line graphs shows trends in CO_2 emissions in Indiana since 1990. Students complete questions related to the graph. Students are asked to find out the years when Indiana had the most/least emissions.



P 108—Student Sheet

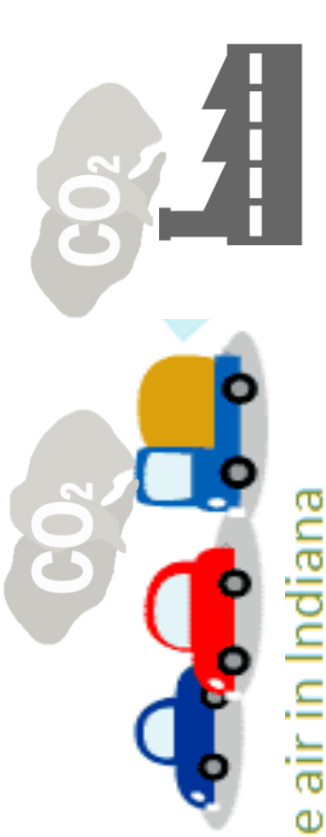


P 109—Student Sheet



P 110—Student Sheet

The line graph below shows how much carbon dioxide (CO_2) Indiana has sent into the air since 1990.



Carbon dioxide sent into the air in Indiana

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indiana total	206	202	199	204	204	209	214	217	219	225	238	229	232	237	238	237	235	235	232	209	220

Millionmetric tons

250
240
230
220
210
200
190
180
170

1. In which year did Indiana emit the most CO_2?

2. In which year did Indiana emit the least CO_2?

3. What is the difference between the most and least CO_2 Emissions?

4. In which year did Indiana emit less CO_2 than it did in 2010?

A 1995

B 1999

C 2002

D 2007

5. In which year did CO_2 emissions decrease the most in Indiana?

F 1992

G 1994

H 2001

J 2009

6. In which year did CO_2 emissions increase the most in Indiana?

A 1993

B 2000

C 2004

D 2010

7. In which year did Indiana emit as much CO_2 as in 2009?

F 1990

G 1995

H 2000

J 2005

8. How many years did Indiana emit less CO_2 than in 1990?

A 0

B 4

C 6

D 12

